TRANSACTIONS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

VOL. XIII.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

EDITED BY JOHN HOPKINSON, F.L.S., F.G.S., F.Z.S.,
Assoc. Inst. C.E., Sec. Ray Society.

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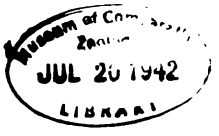

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,, 3.	,, 141–248 and xvii–xx		February, 1908.
,, 4.	,, 249–284, i–viii, and xxi–lx		September, 1908.

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TRANSACTIONS OF THE WATFORD NATURAL HISTORY SOCIETY.

Vol. I.	(pp. lxiv and 248.)		August, 1878.
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PROCEEDINGS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

245TH ORDINARY MEETING, 23RD OCTOBER, 1905, AT WATFORD.

JOHN WEALL, Esq., Treasurer, in the Chair.

Mr. Howard Brooks, Mr. Robert Grieve, and Mr. Benjamin Seebohm were elected Members of the Society.

Mr. John William Edward Heath, F.C.S., Heathcote, Kingsfield Road, Watford, and Mr. Henry Crunden Sargent, Graemes Dyke, Berkhamsted, were proposed for membership.

The following papers were read :—

1. "Natural History Notes from Western Australia." By Alan F. Crossman, F.L.S., F.Z.S., M.B.O.U.

2. "The River-System of Western Hertfordshire." By Alfred Sutton, Assoc. R.S.M. (*Transactions*, Vol. XIII, pp. 1–4.)

Mr. Sutton exhibited a diagram in illustration of his paper.

246TH ORDINARY MEETING, 14TH NOVEMBER, 1905, AT ST. ALBANS.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

Mr. J. W. E. Heath, F.C.S., and Mr. H. C. Sargent were elected Members of the Society.

The following lecture was delivered :—

"Nature at Work and Play." By Richard Kearton, F.Z.S.

The lecture was illustrated by lantern-slides, the lantern being kindly supplied and operated by Mr. Charles Ashdown, F.C.S.

247TH ORDINARY MEETING, 11TH DECEMBER, 1905, AT WATFORD.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

Mr. William Francis Cooper, B.A. (Cantab.), F.C.S., F.Z.S., F. Phil. Soc. Camb., 7, Grosvenor Road, Watford; Mr. Robert E. Groves, Hatfield Road, St. Albans; and Mr. L. E. Robinson, 7, Grosvenor Road, Watford, were proposed for membership of the Society.

The following lecture was delivered:—

"Wonders and Romance of Insect-Life." By Frederic Enock, F.L.S., F.R.M.S., F.E.S., F.R.H.S.

The lecture was illustrated by lantern-slides.

248TH ORDINARY MEETING, 9TH JANUARY, 1906, AT St. ALBANS.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

Mr. W. F. Cooper, B.A., F.C.S., F.Z.S., Mr. R. E. Groves, and Mr. L. E. Robinson were elected Members of the Society.

The following papers were read:—

1. "British Zoophytes." By G. E. Bullen.

2. "Witches' Brooms." By James Saunders, A.L.S. (*Transactions*, Vol. XIII, pp. 67–78.)

Both papers were illustrated by lantern-slides, and Mr. Bullen's by specimens also.

A collection of insects was exhibited by Mr. A. E. Gibbs, F.L.S., and some birds recently added to the Hertfordshire County Museum were shown by Mr. Bullen.

249TH ORDINARY MEETING, 29TH JANUARY, 1906, AT WATFORD.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

The following lecture was delivered:—

"Wild Nature's Ways." By Richard Kearton, F.Z.S.

The lecture was illustrated by lantern-slides.

250TH ORDINARY MEETING, 12TH FEBRUARY, 1906, AT WATFORD.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

The following lecture was given:—

"Geological Photographs." By William Whitaker, B.A., F.R.S., F.G.S., Assoc. Inst. C. E.

The lecture was illustrated by lantern-slides from the Collection of the Geological Photographs Committee of the British Association.

Mr. W. R. Carter, B.A., and Mr. Arthur Wheelwright were appointed auditors of the accounts for 1905.

251ST ORDINARY MEETING, 6TH MARCH, 1906, AT ST. ALBANS.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

Mr. and Mrs. Frank Pratt, Hazelmere, The Broadway, Watford, were proposed for membership of the Society.

The following papers were read :—

1. "Notes on Lepidoptera observed in Hertfordshire in the year 1905." By A. E. Gibbs, F.L.S., F.R.H.S. (*Transactions*, Vol. XIII, pp. 5–9.)

2. "Coleoptera new to the Hertfordshire Fauna." By E. G. Elliman and C. T. Gimingham. (*Transactions*, Vol. XIII, p. 10.)

3. "Notes on Land and Fresh-water Mollusca observed in the Neighbourhood of St. Albans." By G. E. Bullen. (*Transactions*, Vol. XIII, pp. 11–13.)

4. "Notes on Birds observed in Hertfordshire during the year 1905." By William Bickerton. (*Transactions*, Vol. XIII, pp. 49–64.)

The papers were illustrated by specimens and photographs.

252ND ORDINARY MEETING, 20TH MARCH, 1906, AT ST. ALBANS.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

Mr. and Mrs. Frank Pratt were elected Members of the Society.

The following lecture was delivered :—

"Nature's Protection of Insect-Life." By Frederic Enock, F.L.S., F.R.M.S., F.E.S., F.R.H.S.

The lecture was illustrated by lantern-slides in natural colours prepared by the lecturer by three-colour photography.

31ST ANNIVERSARY MEETING, 26TH MARCH, 1906.
(AT WATFORD.)

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

The Report of the Council for the year 1905, and the Treasurer's Account of Income and Expenditure, were read and adopted.

Arthur Cottam, F.R.A.S., Furzebank, Durleigh Road, Bridgewater, was elected a Corresponding Member of the Society.

The President delivered an Address on "Inorganic Evolution." (*Transactions*, Vol. XIII, pp. 15–32.)

The following gentlemen were duly elected as the Officers and Council for the ensuing year:—

President.—John Morison, M.D., D.P.H., M.R.C.S., F.G.S.

Vice-Presidents.—John Attfield, M.A., Ph.D., F.R.S., F.C.S., F.I.C.; Lewis Evans, F.S.A., F.R.A.S.; B. Daydon Jackson, F.L.S.; Edward Mawley, F.R. Met. Soc., F.R.H.S., V.M.H.

Treasurer.—John Weall.

Honorary Secretaries.—A. E. Gibbs, F.L.S., F.R.H.S.; Arthur Sutton, Assoc. R.S.M.

Editor.—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.R.Met. Soc., Assoc. Inst. C.E., Sec. Ray Soc.

Librarian.—Daniel Hill, F.R.H.S.

Other Members.—Philip J. Barraud, F.E.S.; W. R. Carter, B.A.; A. E. Cox, M.R.C.S., L.R.C.P.; Arthur E. Ekins, F.C.S., F.I.C.; Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., F.R.S., V.P.S.A.; Henry Kidner, F.G.S.; Vernon P. Kitchin, B.A., F.E.S.; George W. Lamplugh, F.R.S., F.G.S.; T. E. Lones, M.A., LL.D., B.Sc.; James K. Riggall; the Right Honourable the Earl of Verulam; Henry J. Worssam.

The thanks of the Society were accorded to Sir John Evans, K.C.B., retiring from the office of Vice-President, and to Mr. W. Bickerton, Mr. E. T. Burr, and Mr. W. Lepard Smith, retiring from the Council; also to the Auditors, Mr. W. R. Carter and Mr. A. H. Wheelwright.

Report of the Council for the Year 1905.

Except from a financial point of view the Society has maintained its position during the past year. In order to give members residing in the central and eastern divisions of the county fuller opportunities of taking part in the proceedings, the meetings have during the present session been divided more equally than hitherto between Watford and St. Albans, and popular lectures have been given at both centres. There has been an increased attendance, and the popular lectures have attracted good audiences.

The Society has to deplore the loss by death of the Right Hon. the Earl Cowper, K.G., the Right Hon. Baron Grimthorpe, LL.D., and Mr. George Rooper, F.Z.S. Earl Cowper and Mr. Rooper had both filled the office of President of the Society, and the latter was one of the original members.

Mr. Rooper was well known as a sportsman-naturalist, was an excellent observer of nature, and the author of several popular works on sport showing a very intimate knowledge of the habits of animals. He acted for two years as the Society's Recorder of Birds, and besides his Anniversary Addresses and annual reports on our birds, contributed several zoological papers to our

'Transactions.' He died at his residence, Nascot House, Watford, at the advanced age of 93.

The removal of Mr. Arthur Cottam, F.R.A.S., to a distant part of the country is a serious loss to the Society, of which he was one of the founders. As an ardent entomologist and microscopist he has contributed much valuable matter to the 'Transactions.' It is hoped that, as a Corresponding Member, he will still maintain an active connection with the Society.

Including the above, the Society has lost, during the year, by death or resignation, twelve Ordinary Members, and twelve Members have been elected. The census at the end of the years 1904 and 1905 was therefore identical, as follows:—

	1904.	1905.
Honorary Members	13	13
Corresponding Members	5	5
Life Members	44	44
Annual Subscribers	93	93
	155	155

Eight Ordinary Meetings, as well as the Anniversary Meeting, were held during the year, and the following papers and lectures were read or delivered:—

Jan. 25.—The Upper Regions of the Atmosphere; by W. Marriott, F.R.Met.Soc.

Feb. 22.—Hertfordshire Maps and Topographical Works; by H. G. Fordham.

March 8.—Anniversary Address: The History of Botanic Illustration; by the President, B. Daydon Jackson, F.L.S.

—— 29.—Remarks on the Rainfall and Temperature in Hertfordshire in 1904; by John Hopkinson, F.L.S., F.G.S., V.P.R.Met.Soc.

—— Notes on Lepidoptera observed in Hertfordshire in the year 1904; by A. E. Gibbs, F.L.S., F.R.H.S.

—— Notes on Variation in *Melitæa aurinea*; by V. P. Kitchin, B.A.

—— Coleoptera observed in Hertfordshire in 1904; by E. G. Elliman.

—— A Neolithic Celt found near Berkhamsted Common; by Sir John Evans, K.C.B., D.C.L., Sc.D., F.R.S., etc.

April 12.—Report on Phenological Phenomena observed in Hertfordshire during the year 1904; by Edward Mawley, F.R.Met.Soc., F.R.H.S., V.M.H.

—— On some recently-exposed Beds in the Valley of the Gade at and near Hunton Bridge; by T. E. Lones, M.A., LL.D., B.Sc.

—— Note on the Comparative Rate of Growth of a Pedunculated and a Sessile Oak at Bayfordbury, Hertford; by John Hopkinson, F.L.S., F.G.S., F.R.M.S., etc.

—— Notes on Birds observed in Hertfordshire during the year 1904; by William Bickerton.

—— Report on the Conference of Delegates to the British Association at Cambridge in 1904; by John Hopkinson, F.L.S., F.G.S., V.P.R.Met.Soc.

Oct. 23.—Natural History Notes from Western Australia; by Alan F. Crossman, F.L.S., F.Z.S., M.B.O.U.

—— The River-System of Western Hertfordshire; by Alfred Sutton, Assoc.R.S.M.

Nov. 14.—Nature at Work and Play; by Richard Kearton, F.Z.S.

Dec. 11.—Wonders and Romance of Insect-Life; by Frederic Enock, F.L.S., F.E.S., F.R.M.S., F.R.H.S.

Seven Field Meetings, most of which were well attended, were held during the spring and summer, as follows:—

April 8.—Welwyn and Datchworth.
,, 15.—Flitwick and Silsoe.
May 6.—Moor Park, Rickmansworth.
,, 20.—Gorhambury, St. Albans.
June 3.—St. Peter's, St Albans.
,, 27.—Kew Gardens.
July 1.—Aldenham Abbey and Otterspool, Watford.

The best thanks of the Society are due to the Right Hon. the Earl of Verulam, to the President, Dr. Morison, and to Mr. J. Pierpoint Morgan, for receiving or entertaining the members at Gorhambury, St. Albans, and Aldenham Abbey, respectively.

The meetings on April 8th and 15th were held in conjunction with the Geologists' Association, that on May 6th was held in conjunction with the Selborne Society, and that on May 20th in conjunction with the St. Albans Archæological Society.

Three parts of the 12th volume of the Society's 'Transactions' were issued during the year, comprising 120 pages and with six plates and eight illustrations in the text.

The usual exchanges with other Societies have been made, and several additions have also been made to the Library by donations and purchase. The Council has not been able as yet to find more suitable library accommodation, and regrets that the books remain not readily accessible to the members. The Librarian will, however, be pleased to forward any work on application, and to furnish information regarding the contents of the catalogue, which cannot be reprinted at present for lack of funds.

Notwithstanding a generous donation by the President, Mr. B. Daydon Jackson, towards reducing the deficit of the past year, it is regretted that the accounts again show an adverse balance, in view of which fact it will be impossible to carry on the work of the Society on the same scale as hitherto, especially as regards the publication of the 'Transactions,' unless a considerable increase in the number of subscribing members can be obtained. The Council has done its utmost to maintain, and even to increase, the benefits of membership, and therefore appeals to the members generally for aid in bringing in new subscribers and active members, so that the work of the Society may be continued in a manner consistent with its honourable traditions.

The best thanks of the Society are due to the Watford Urban District Council for kindly allowing the free use of the Council Chamber for the evening meetings, and of the old Board Room for the storage of the Library.

INCOME AND EXPENDITURE FOR THE YEAR 1905.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Entrance Fees	6	0	0	By Balance, being amount overdrawn	10	13	2
„ Subscription for 1903	0	10	0	„ Printing 'Transactions' *	27	19	3
„ Subscriptions for 1904	2	10	0	„ Miscellaneous Printing	11	4	2
„ „ „ 1905	39	0	0	„ Expenses of Meetings (less receipts *per contra*)	13	6	0
„ „ „ 1906	6	10	0	„ Library Expenses	3	12	9
„ Sale of 'Transactions' (£6 2s. 8d.), and 'Flora of Herts' (9s. 4d.)	6	12	0	„ Salary of Assistant	5	0	0
„ Mr. Kearton's Lecture at St. Albans (less expenses *per contra*)	7	0	8	„ Postages and Carriage of Parcels	12	4	11
„ Donation from Mr. Daydon Jackson	5	0	0	„ Fire Insurance Premium	0	12	6
„ Dividends on £130 India 3 per cent. Stock	3	18	0	„ Stationery	3	13	0
„ Balance, being amount overdrawn	11	7	1	„ Printing on Cheques	0	2	0
	£88	7	9		£88	7	9

* Due for same £7 8s. 3d.

Amount invested in the purchase of £130 India 3 per cent. Stock . . . . £126 15s. 6d.

Audited and found correct, 22nd March, 1906 { W. R. CARTER. A. H. WHEELWRIGHT.

Additions to the Library in 1905.

Presented.

British Association for the Advancement of Science. Report for 1904 (Cambridge). 8vo. London, 1905 .	*The Association.*
British Museum (Natural History). Guide to the Fossil Mammals and Birds. 8th ed. 8vo. London, 1904	*The Trustees.*
———. Guide to the Birds' Gallery. *Ib.* 1905 . .	,,
———. Guide to the Exhibition of old Natural History Works up to the time of Linnæus. *Ib.*	,,
Despard, R. E. Description of the Improvements on the Second Division of the River Lea Navigation. (*Proc. Inst. C. E.* 1857–58.) With Map added	*Mr. W. Whitaker.*
Evans, Sir J. Egypt Exploration Fund. The President's Address, 1905. 8vo. Bristol, N.D. . . .	*The Author.*
Fordham, H. G. Cambridgeshire Maps. (*Cambr. Antiq. Soc.'s Communications*, vol. xi, pp. 101–172.) 4to .	,,
Geological Survey of the United Kingdom. Summary of Progress for the year 1904. 8vo. London, 1905 .	*The Director.*
London County Council. Third Annual Report of the Horniman Museum. 8vo. London, 1904 . . .	*The Council.*
Massee, G. On the Origin of Parasitism in Fungi. (*Phil. Trans. Royal Soc.*, vol. clxxix, 1904.)	*The Author.*
Strahan, A. Notes on the Relation of the Lincolnshire Carstone. (*Quart. Journ. Geol. Soc.* 1886.) . . .	*Mr. W. Whitaker.*
Symons' Meteorological Magazine. Vol. xxxix, January, 1905; vol. xl, February–December, 1905 . . .	*Dr. H. R. Mill.*
Whitaker, W. Maps showing the Area of Chalk available for Water Supply in the London Basin. (*Trans. Sanitary Inst.*, vol. xiii, 1892.)	*The Author.*
———. Some Middlesex Well Sections. (*Trans. Brit. Assoc. Waterworks Engineers*, vol. ii, 1897.) . . .	,,
———, and A. J. Jukes-Browne. On Borings at Culford, Winkfield, Ware, and Cheshunt. (*Quart. Journ. Geol. Soc.*, vol. l, 1894.)	*The Authors.*

Received in Exchange.

Barrow Naturalists' Field Club. Annual Report for the year ending 25th March, 1899. 8vo. Kendal, 1900.

Bath Natural History and Antiquarian Field Club. Proceedings. Vol. x, no. 4. 8vo. Bath, 1905.

Belfast Naturalists' Field Club. Proceedings. Ser. 2, vol. v, part 4. 8vo. Belfast, 1905.

Boston Society of Natural History. Proceedings. Vol. xxxi, nos. 2–10; vol. xxxii, no. 1. 8vo. Boston, U.S.A., 1903–4.

Bristol Naturalists' Society. Proceedings. N.S., vol. v, part 1; vol. vi, part 3; vol. viii, parts 2 and 3; vol. x, parts 1–3. Ser. 4, vol. i, part 1. 8vo. Bristol, 1886–1905.

Caradoc and Severn Valley Field Club. Transactions. Vol. iii, no. 4. 8vo. Shrewsbury, 1905. Caradoc Record of Bare Facts, 1904. *Ib.*

Cardiff Naturalists' Society. Transactions. Vols. xxxvi and xxxvii. 8vo. Cardiff, 1904–5.

Chester Society of Natural Science, Literature, and Art. Proceedings for 1904–5. 8vo. Chester, 1905.

Croydon Natural History and Scientific Society. Proceedings for 1904–5. 8vo. Croydon, 1905.

Edinburgh, Botanical Society of. Transactions and Proceedings. Vol. xxii, part 3. 8vo. Edinburgh, 1904.

——— Royal Physical Society. Proceedings. Vol. xvi, no. 2. 8vo. Edinburgh, 1905.

GLASGOW, NATURAL HISTORY SOCIETY OF. Transactions. N.S., vol. vii, part 1. 8vo. Glasgow, 1904.

LONDON, GEOLOGICAL SOCIETY OF. Abstracts of the Proceedings. Session 1904–5. 8vo. London, 1905.

———. GEOLOGISTS' ASSOCIATION. Proceedings. Vol. xix, nos. 3–5. 8vo. London, 1905.

———, LINNEAN SOCIETY OF. Proceedings. 117th Session, 1904–5. 8vo. London, 1905.

———, ———. List of the Society. 1904–1905. 8vo. London, 1905.

———. QUEKETT MICROSCOPICAL CLUB. Journal. Ser. 2, vol. ix, nos. 56 and 57. 8vo. London, 1905.

———. ROYAL METEOROLOGICAL SOCIETY. Quarterly Journal. Vol. xxxi. 8vo. London, 1905.

———. ———. Meteorological Record. Vol. xxiv, nos. 94–96. 8vo. London, 1905.

———. ROYAL MICROSCOPICAL SOCIETY. Journal. 1905. 8vo. London, 1905.

MANCHESTER FIELD NATURALISTS' AND ARCHÆOLOGISTS' SOCIETY. Proceedings for the year 1904. 8vo. Manchester, 1905.

——— GEOGRAPHICAL SOCIETY. Journal. Vol. xxx, parts 4–12. 8vo. Manchester, 1905.

——— GEOLOGICAL AND MINING SOCIETY. Transactions. Vol. xxviii, parts 13–15. 8vo. Manchester, 1905.

——— LITERARY AND PHILOSOPHICAL SOCIETY. Memoirs and Proceedings. Vol. xlix, parts 2 and 3. 8vo. Manchester, 1905.

——— MICROSCOPICAL SOCIETY. Transactions for 1904. 8vo. Manchester, 1905.

NEW YORK ACADEMY OF SCIENCES. Annals. Vol. xiv, Index; vol. xv, Index; vol. xvi, parts 1 and 2. 8vo. New York, 1905.

——— ———. Memoirs. Vol. ii, part 4.—The Development of the Vascular and Respiratory Systems of *Ceratodus*, by W. E. Kellicott. 4to. New York, 1905.

——— STATE LIBRARY. 86th Annual Report, for the year 1903. 8vo. Albany, 1904.

——— STATE MUSEUM. 56th Annual Report, for the year 1902. 4 vols. 8vo. Albany, 1903.

——— ———. Bulletins. No. 44.—Lime and Cement Industries of New York, by H. Reis; Cement Industry in New York, by E. C. Eckel (1901). 63.—Stratigraphical and Paleontological Map of Canandaigua and Naples Quadrangle, by J. M. Clarke and D. D. Luther (1904). 69.—Report of the State Paleontologist, J. M. Clarke (1902). 70.—List of New York Mineral Localities, by H. P. Whitlock (1903). 71.—Feeding Habits and Growth of *Venus mercenaria*, by E. P. Felt (1903). 73.—Metallic Ornaments of the New York Indians, by W. M. Beauchamp (1903). 74.—Monograph of the Genus *Saperda*, by E. P. Felt and L. H. Joutel (1904). 75.—Report of the State Botanist, G. H. Peck (1904). 76.—Injurious and other Insects of the State of New York, 1903, by E. P. Felt (1904). Geology of the Vicinity of Little Falls, Herkomer County, by H. P. Cushing (1905). A History of the New York Iroquois, by W. L. Beauchamp (1905). Mosquitos or Culicidæ of New York State, by E. P. Felt (1904). Report of the State Paleontologist, J. M. Clarke (1905). 81.—Geology of the Watkins and Elmira Quadrangles, by J. M. Clarke and D. D. Luther (1905). 82.—Geologic Map of the Tully Quadrangle, by J. M. Clarke and D. D. Luther (1905). 8vo. Albany.

———, UNIVERSITY OF THE STATE OF. College Department. 5th and 6th Annual Reports, for 1902 and 1903. 8vo. Albany, N.Y., 1903–4.

NORFOLK AND NORWICH NATURALISTS' SOCIETY. Transactions. Vol. vii, part 5. 8vo. Norwich, 1904.

NORTHAMPTONSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB. Journal. Vol. xii, nos. 97–100, title-page and index. 8vo. Northampton, 1904.

NORTH STAFFORDSHIRE FIELD CLUB. Transactions. Vol. xxxix. 8vo. Stafford, 1905.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES. Proceedings. Vol. lvi, part 3; vol. lvii, parts 1 and 2. 8vo. Philadelphia, Pa., 1905.

ROCHESTER ACADEMY OF SCIENCE. *Cratægus* in Rochester, New York; by C. S. Sargent. (Proceedings, vol. iv.) 8vo. Rochester, N.Y., 1903.

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253RD ORDINARY MEETING, 2ND APRIL, 1906, AT WATFORD.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

A letter was read from Mr. Arthur Cottam, F.R.A.S., thanking the Society for his election as a Corresponding Member.

Mr. W. Percival Westell, F.R.H.S., M.B.O.U., Glenferrie Road, St. Albans, was proposed for membership of the Society.

The following papers were read :—

1. "On a Recent Palæolithic Discovery near Rickmansworth." By Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., F.R.S., etc. (*Transactions*, Vol. XIII, pp. 65–66.)

Specimens of flint implements, and photographs, were exhibited in illustration of the paper.

2. "The Weather of the year 1905 in Hertfordshire." By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E. (*Transactions*, Vol. XIII, pp. 33–48.)

Diagrams of the temperature and rainfall were exhibited in illustration of the paper.

3. "Report on Phenological Phenomena observed in Hertfordshire during the year 1905." By Edward Mawley, F.R.Met.Soc., F.R.H.S., V.M.H. (*Transactions*, Vol. XIII, pp. 81–88.)

4. "Ostracoda and Mollusca from the Alluvial Deposits at the Watford Gas Works." By John Hopkinson, F.L.S., F.G.S., etc. (*Transactions*, Vol. XIII, pp. 79–80.)

5. "Albino Moles in Hertfordshire." By A. E. Gibbs, F.L.S., F.R.H.S. (*Transactions*, Vol. XIII, p. 14.)

6. "Report on the Conference of Delegates to the British Association in London in 1905." By John Hopkinson, F.L.S., F.G.S., etc.

The meeting of the British Association having this year been held in South Africa, it was considered by the Corresponding Societies Committee that it would be the most convenient course to hold the Conference of Delegates in London. The Council having approved of this, the opportunity was taken of a meeting of the General Committee on October 31, which the Delegates of Affiliated Societies have the right to attend, to hold the Conference on that and the preceding day.

The Conference was held in the Rooms of the Linnean Society, Burlington House, and both the meetings were well attended. On the evening of the first meeting the Delegates were hospitably entertained at dinner by the Royal Societies Club.

Both meetings of the Conference were presided over by Dr. A. Smith Woodward, F.R.S. The Corresponding Societies Committee was represented, amongst others, by the following members of our Society:—Dr. H. R. Mill, Mr. F. W. Rudler (Secretary), Mr. W. Whitaker, F.R.S. (Chairman of the Committee), and your Delegate, who contributes this report.

First Meeting.

The Report of the Corresponding Societies Committee stated that there would henceforth be two classes of local Societies eligible for relationship with the British Association. One of these, to be called Affiliated Societies, would consist, as at present, of such Societies as undertake local scientific investigation and publish the results, and the other, to be called Associated Societies, of those formed to encourage the study of science, which have been founded for at least three years, and number not less than fifty members. An Affiliated Society must appoint as its Delegate a *Member* of the Association, who will for the meeting he attends be a Member of the General Committee. An Associated Society may appoint either a *Member* or *Associate* of the British Association, who will have all the rights of a Delegate of an Affiliated Society except that of membership of the General Committee. Our Society, it is scarcely necessary to say, belongs to the first class: the Watford Camera Club has been elected into the second class of Corresponding Societies.

The Report also dealt with the question of the establishment of a 'Journal of the Corresponding Societies,' which was deemed to be impracticable, and with that of reduced railway-fares to members of local Scientific Societies, etc.

The Chairman, in his opening Address, dealt mainly with the work, and play, of local Scientific Societies. He said that he began his scientific career as a member of the small Society at one time flourishing in his native town, and he then learned how to write his observations in a logical form. None but those who

have associated with the scientific men of other countries, and have seen the isolation in which most of them are accustomed to work, could appreciate the service here rendered to the cause of science by our small provincial Societies, which furnish a great stream of recruits to our large metropolitan Societies.

He thought that some Societies reduced their efficiency and even endangered their existence as scientific bodies by making their excursions into luxurious picnics, natural history forming a subordinate part of the programme.

With regard to evening meetings he said that the most active of the metropolitan Societies make a special feature of exhibits while taking the majority of papers as read; and he deprecated the reading of original papers of a technical nature, thinking that it would be better to get real workers to treat of unsolved problems of the sciences in which they are interested.

He deprecated the publication by local Societies of technical scientific papers which would be accepted by the great metropolitan Societies, but advocated original researches being brought before local meetings for discussion, by which benefit might be derived by the authors. Matters, chiefly of local interest, which it was advisable to publish on the spot, should form the bulk of the local Society's annual issue.

The local Societies might, he said, exert influence with our smaller public libraries in the selection of books on science. Not only is a student of small means unable to borrow from this source the ordinary standard treatises which should be provided, but he can rarely find even the most important books descriptive of the natural history of the district in which the library is situated. They should at least insist that the more important of the larger educational works on science be properly chosen and made available for reference.

The main object for which the Conferences of Delegates were established was, he thought, to lead to more definite concerted action or co-operation between local Societies in prosecuting certain specified lines of research, but suggestions had been made and enquiries had been started year after year without, in most cases, any satisfactory response, individualism pervading our Scientific Societies as it does everything distinctively British. "Nevertheless," he said in conclusion, "this Conference has other and perhaps equally important uses. It enables the chosen representatives of the various Societies to discuss many general questions in which all are interested; it brings together many active workers whose exchange of ideas, in private conversation quite as much as in public meeting, tends to the advancement of our common object; and if none of our resolutions have much binding force in plans for organized research, there cannot be any doubt as to the value of the union in friendship which results from the intercourse that is held."

A long discussion as to the proper work for local scientific Societies and the methods of pursuing it followed the Address.

Mr. William Martin, M.A., LL.D., introduced the subject of "The Law of Treasure Trove, especially in relation to Local Scientific Societies." He said that when gold or silver was put by with a view to reclamation, all knowledge of the deposit and of the depositor having vanished, the treasure accrues *in jura regali* to the Crown, the essentials of treasure trove being an advertent depositing. The Crown, when treasure trove reaches the hands of the Treasury, remunerated the finder to an extent proportionate to the value of the articles retained, and they are sent to the British Museum or to some other public institution; or if the articles are not required they are returned to the finder. If the law of treasure trove were abolished the finder would as a rule in his ignorance dispose of the find for much less than its value, and the treasure would rarely find its way into public museums, while in many cases it would pass from hand to hand until all knowledge of the locality of the find and of attendant circumstances might be lost. He thought that *more* law of treasure trove was required rather than *less*. It should be extended so as to include, "with adequate safeguards and inducements, all objects of distinct antiquarian value, whether of gold or silver, or not, and irrespective of any requirement of proof or presumption as to their having been originally hidden." ('Juridical Review,' vol. xv, p. 227.)

Dr. Martin then suggested that in cases of treasure trove the procedure should be through the Post Office officials throughout the country, as for many reasons to be preferred to the Police officers. Notice of the liberal terms offered by the Treasury should be disseminated; the articles should be given up to the local Postmaster; and a receipt should be given by him to the finder, with a counterfoil and an addressed envelope in which to send the receipt, or the counterfoil, to, say, the Solicitor to the Treasury. If it were known, he thought, that the finder's interests were enhanced by the delivery of the articles into proper custody, much of what otherwise would be lost or cast into the melting-pot would be preserved for future generations.

A discussion followed, in the course of which:

Mr. T. Sheppard, Curator of the Hull Museum, said that his experience was that everything discovered was looked upon as Crown property, neither the finder nor the owner of the land expecting anything in return. The suggestions with regard to Post Offices and to the extension of this law to all antiquities required careful consideration. The number of articles brought to the Hull Museum as "antiquities" was appalling.

Your Delegate said that while he thought it to be a general belief that the finder was paid nearly the bullion value of the articles found, it was not generally appreciated that now, in accordance with the regulations made in 1886, on the suggestion of Sir John Evans, the finder got the archæological value, which may sometimes be much more than the bullion value, such value, however, being subject to a deduction of 20 per cent., which

he thought would act as a deterrent to the objects being sent to the Treasury. He thought that a notice as to the law ought to be put up at all post offices throughout the kingdom. The law, in his opinion, bore unjustly on local museums, which should have a prior right of purchasing the objects at their value.

Questions were asked as to the delegation by the Crown of its rights, and were answered by Dr. Martin, and in reply to a question as to treasure trove thrown up by the sea he said that it was not really treasure trove, but probably belonged to the Crown under the technical expression Droits of the Admiralty.

Mr. W. Morris Colles then opened a discussion on "The Law of Copyright as affecting the Proceedings of Scientific Societies." He said that the ordinary rules of copyright applied to papers which were published by being placed on sale, but if they were privately printed, the copyright, unless assigned, remained in the authors by common law. Some Societies had bye-laws declaring the copyright of all accepted papers to be vested in them, but it was questionable whether these bye-laws were sufficient to give them a good title to the copyright without assignment by a legal document in such a form as to hold good against the members contributing papers or against infringers. It was in fact a case which could only be met by special contract.

Mr. Harold Hardy dealt with the position of the author of a paper read at a meeting of a Society. If the audience consisted merely of members of the Society or a limited number of persons invited or admitted by ticket, the author was entitled to copyright as in an unpublished manuscript. But if the public generally were admitted, the author could only protect his copyright by one of two methods. He could print and publish it before oral delivery and register it at Stationers' Hall, or he could give two days' notice to two magistrates living within five miles of the place where the paper was to be read, by which procedure he would acquire copyright for twenty-eight years only. Mr. Hardy suggested that oral lectures should be protected in a similar way to that in which dramatic compositions are secured, the author of a play having copyright and the right of representation in public. It would be a lecturing right.

Dr. H. R. Mill said that he thought a scientific man did not wish to keep the result of his investigations to himself, once it was given to a Society: he surely desired his paper to be as widely known and as much quoted as possible.

SECOND MEETING.

Professor G. S. Boulger introduced the subject of "The Preservation of our Native Plants." He first spoke of the danger of their extermination by inevitable causes such as encroachments of the sea and the increasing density of population, and then of avoidable causes such as the thoughtless excesses of children, tourists, and botanists, and the work of trade collectors, who mainly collect such plants as primroses and ferns which can

be obtained in large quantities. Botanists, he said, often root up numerous specimens of non-variable species, partly for the purpose of exchange, but even the gathering of blossom may endanger the continuance of annuals by preventing the formation of seed. Protective measures were then discussed by him, and the conclusion was arrived at that we must mainly depend upon the development of a general sentiment in favour of the conservation of our natural beauties, nothing conducing to this end more than education. As this must be tardy, and the existing law is inadequate, legislation appeared to be required, and it was proposed to introduce a Bill on the lines of the Wild Birds' Protection Act, applying only to persons over fourteen years of age as principals, and exempting occupiers of land and those authorized by them, but authorizing the scheduling of species, and of districts or whole counties.

The Rev. R. Ashington Bullen said that the whortleberry had been destroyed in his district (Woking) by incendiary fires, and at Reigate the filling-up of a bog in order to make golf-links had doubtless resulted in the extirpation of the sundew.

Mr. Longden of Stanton suggested that a circular should be sent to school-teachers calling their attention to the subject with a view to their interesting the children under their care in the preservation of our wild flowers.

Mr. H. Coates said that the Perthshire Society of Natural Science had jealously guarded Ben Lawers as specially its own preserve, and favoured the suggestion, which his Society might be able to carry out, to establish gardens for the cultivation of wild plants which are in danger of extermination.

Mr. W. Grey said that the flowers and ferns which used to decorate the roads and hedges in the neighbourhood of Belfast were being exterminated, and he thought that nothing would prevent these depredations except law, but care should be taken to give facilities to the scientific collector.

Mr. W. Marsh mentioned that they had about 4,000 children in Leeds who were beginning to take an interest in wild flowers, and as these children went out into the country their depredations were likely to be serious.

Your Delegate gave an account of the depredations of dealers in ferns in the neighbourhood of St. Albans some thirty years ago, when several species which then adorned their lanes and woods were extirpated. He thought the idea of a circular a good one, and that it should be carried out before any legal Act could be obtained, which would take a considerable time.

Mr. Whitaker thought that collectors had been unfairly treated, the offenders being the people who buy the things. Much harm done was due to the craze some people had for filling their rooms with cut flowers.

The Chairman said that a certain Moss Litter Company had completely ruined one of the most prolific floras near his native town. He thought the subject should not be allowed to drop.

Professor Boulger in his reply mentioned that *Eryngium campestre* had been exterminated by golf at New Romney, Kent, and that a rare species of *Clematis* was in danger of extermination at Staaten Island on the other side of the Atlantic from the same cause. He had noticed that at Cheddar the cottagers root up *Thalictrum montanum*, but not the Cheddar pink, which is mostly cultivated in gardens. The danger with regard to Nature-study was a great one, and rare flowers could only be prevented from being exterminated by keeping the knowledge of their localities to oneself. He saw that the meeting generally was in favour of the issue of a circular, possibly in connection with the publication of a "reader." With regard to legislation he thought it would not do its work unless backed by public interest, but he believed it to be absolutely necessary.

The remainder of the meeting was devoted to reports from some of the Sectional Committees of the Association.

Section C (*Geology*).—The Delegates were asked to assist the following Research Committees:—(1) Erratic Blocks; (2) Trias Committee; (3) Geographical and Geological Names. The first of these Committees has been at work for many years, but still asks for information on the distribution of erratic blocks. The third is a new Committee which can only properly discharge its duties by the co-operation of the local Societies.

Section D (*Zoology*).—The following subjects are suggested as worthy of local attention:—The study of the fresh-water plankton and of the Rotifera of East Anglia [and elsewhere].

Section E (*Geography*).—To assist a new Committee by sending data of the composition and value of rainfall and discharge of rivers and lakes; and also the third Committee under *Geology*.

Section I (*Physiology*).—To aid a new Committee in considering the effect of local climate on health and disease. Medical men and meteorologists can render great help to this Committee.

Members of the Society and others willing to assist any of these Committees are desired to communicate with the writer of this report; or with the Secretary of the British Association at Burlington House, London, W.

VISIT TO THE NATURAL HISTORY MUSEUM, SOUTH KENSINGTON, 28TH APRIL, 1906.

The chief object of this visit was to enable members of the Society to examine and have explained to them the cast of the skeleton of the gigantic Dinosaur, *Diplodocus Carnegii*, which has recently been given to the Museum by Mr. Andrew Carnegie.

The members assembled in the Great Hall of the Museum, where they were received by Dr. A. Smith Woodward, F.R.S., Keeper of Geology, who conducted them to the Reptile Gallery, the cast being too large for any of the geological rooms.

Dr. Smith Woodward stated that the skeleton was built up of plaster casts of portions of several specimens, the greater part, including nearly the whole of the vertebral column, and the scapulæ, pelvis, femora, tibiæ, fibulæ, and hind feet being restored from three distinct specimens in the Carnegie Museum, Pittsburg; nearly the whole of the skull being from a specimen in the National Museum, Washington; and the atlas vertebra, some chevron bones, and the fore feet from specimens in the American Museum of Natural History, New York. The original specimens were obtained under great difficulties from the Upper Jurassic rocks of Wyoming. The complete skeleton as restored is 84 ft. 8 in. in length, and 11 ft. 9 in. in height at the hind limbs. The very small head, the long and flexible neck, and the long tail with a whip-like end in which the caudal vertebræ terminate, were remarked upon, the tail being stated to be probably the animal's weapon of offence and defence.

The Dinosauria are an order of huge terrestrial reptiles of which *Diplodocus* belongs to the sub-order Sauropoda, or lizard-footed, *Cetiosaurus*, *Ornithopsis*, and *Brontosaurus* being well-known genera; and portions of the skeletons of these, or casts of them, were examined and compared with *Diplodocus*, the tail of *Cetiosaurus Leedsi*, an animal about 60 feet in length from the Oxford Clay of Peterborough, being noticed to have a similar terminal lash.

As an example of another order, the Sauropterygia, of which *Plesiosaurus* and *Mesosaurus* are characteristic genera, a perfect and finely set-up skeleton of *Cryptoclidus oxoniensis* was examined; this also is from the Oxford Clay of Peterborough. The order contains both marine and terrestrial reptiles.

Passing over the marine order Placodontia, represented by *Cyamodus*, once thought to be a fish, and *Placodus*; as examples of the terrestrial order Anomodontia, skeletons of *Cynognathus crateronotus* and *Pariasaurus Bainii* were examined, the former having a very large head compared to the size of its body, and the latter having an extremely squat appearance, reminding one somewhat of a dachshund.

At the other end of the reptilian scale are the Pterosauria or winged-lizards, of which the genus *Pterodactylus* is so well known from the almost entire skeletons of several species found in the lithographic stone of Bavaria, some of which were seen. In this order is the remarkable genus *Pteranodon*, one species of which, *Pt. occidentalis*, has wings measuring 18 feet across, and although its jaws are 3 feet long it is devoid of teeth.

Passing on to the Mammalia, Dr. Smith Woodward traced the development of the horse and of the elephant as examples of the Ungulata or hoofed animals, showing how the toes of the horse gradually became reduced from four to one, and stating that the present wild horse of South America was not the horse of the aborigines, which became extinct, but the domestic horse brought over by European man. The Pleistocene mammoth, he said,

which ranged over nearly the whole of the northern hemisphere, was almost identical with the living Indian elephant, but its tusks were longer, one being shown measuring 12 ft. 6 in. along the curve. Finally, the form and habits of the Edentata were illustrated by specimens of the ground-sloths *Megatherium* and *Grypotherium*, the latter having probably been kept in caverns by Palæolithic man to be killed for food.

On leaving the Museum, the President, Dr. Morison, proposed a vote of thanks to Dr. Smith Woodward, which was heartily carried.

FIELD MEETING, 5TH MAY, 1906.

ALDBURY, TRING.

The members, who came from Watford, Bushey, Rickmansworth, St. Albans, and elsewhere, about half the number by rail and the rest cycling, assembled at Tring Station and proceeded to the downs of Aldbury Owers, the cyclists first going to Aldbury to leave their bicycles there.

Aldbury was chosen for the first field meeting of the year in order to see the Easter anemone or pasque flower (*Anemone pulsatilla*) in bloom, and it was found to be fairly plentiful on the downs, but mostly a little past its prettiest state.

A walk through Aldbury Owers Wood brought the party to the summit of Pitstone Hill, whence a very fine view was obtained. This point is upwards of 700 feet above mean sea-level, which height is exceeded by Clipper Down, a mile to the north-east (811 feet), and by Coombe Hill, Tring, four and a half miles to the south-east (840 feet), while Coombe Hill, Wendover, eight miles distant in the same direction, rises still higher (952 feet). These are the highest points on the north-eastern termination of the Chilterns, but they do not command any finer view than that obtained from Pitstone Hill.

Here Mr. Hopkinson, the Director of the meeting, pointed out the principal geological features of the district. These, so far as concerns the formations on the north-west, the lower beds of the Chalk with outliers of higher beds of the same formation, the Gault plain with outliers of the Lower Chalk indicating its former extension, and the hills of Lower Greensand beyond, have been fully described in reports of previous field meetings held in the neighbourhood of Aldbury, although this is the first time that Pitstone Hill has been visited, but the interest attaching to this spot in connection with the river-system of the district has not before been alluded to.

At Pitstone, just below, a small stream rises which is one of the tributaries of the Ouse; just beyond Ivinghoe Beacon Hill, seen about a mile away towards the north, is another; and at the same distance to the north-west, a little north of the nearest reservoir (Marsworth), rise several small streams which

form the source of the Thame. In the valley in which Aldbury is situated a stream sometimes flows, but it is soon lost in swallow-holes. This was not always the case, for it was once the source of the Bulbourne, which does not now rise any higher up its valley than Cowroast; it is gradually shrinking not only in length but also in volume, as is its tributary the Gade. On the other hand, the northerly-flowing streams have been cutting their way back into the Chalk escarpment for so long that they have caused the escarpment to recede for many miles, for the present Chiltern Hills are but the south-eastern slopes of a much higher range which by subaerial erosion has gradually been reduced in height and extent.

The party here unexpectedly encountered a brood of plover chicks running about on the grass, and some allowed themselves to be taken up and fondled, but were soon released.

Passing again through the woods, the village of Aldbury was reached by a walk thence through the fields, and tea was had at the "Greyhound." A vote of thanks having then, on the proposition of the President of the Society, Dr. Morison, been accorded to the Director of the meeting, Moneybury Hill on the opposite side of the valley was ascended, and, after further geological remarks had been made, some of the party walked back to Tring Station, while the rest cycled to their respective destinations.

The weather was very pleasant, the warm rays of the sun being tempered by a cool breeze, while the delicate tints of the new foliage gave a charming freshness to the landscape.

Field Meeting, 26th May, 1906.

AYOT GREEN AND HATFIELD.

This was a joint meeting with the Geologists' Association, Mr. Horace Monckton and Mr. Hopkinson being Directors for the London society and the latter also for the County society.

Assembling at Ayot Station, the brickfields near were first visited. Several pits are now open, showing a few good sections, which were examined in descending order, or from newer to older deposits, the newer being to the east. At the highest part is a little boulder-clay, not now well exposed, and below that a bed of gravel referred by Prestwich to the Westleton Shingle. These superficial deposits are only seen near the high road (Hatfield to Welwyn), at the eastern end of the brickfields. Below them is a little of the lower part of the London Clay with its basement-bed, seen in the eastern and central pits. And below again are the Reading Beds, here consisting chiefly of light-coloured sand with pale-grey clay, seen in the central and western pits. The Chalk, on which these beds rest, is not here exposed, but it may be seen in a shallow roadside cutting within half a mile to the south-east, where its junction with the

sands of the Reading Beds is shown; and also in the railway-cutting about the same distance to the west.

A search for fossils in the basement-bed of the London Clay was unsuccessful, but Mr. Hopkinson stated that he had found teeth of several species of shark in the bottom layer of sand and pebbles, and had placed them in the County Museum at St. Albans, and also in this layer imperfectly-preserved shells. Mr. E. T. Newton obtained from a workman some teeth which must have come from this bed, and he has determined them to belong to the sharks *Odontaspis elegans*, *O. cuspidatus*, and *Lamna Vincenti*, and to the teleostean *Phyllodus toliapicus*. The base of the Reading Beds is not exposed; lower beds have, however, been worked, and a workman stated that he had found oyster-shells in them; nor is the Chalk exposed, but it cannot be at any considerable depth below the floor of the present workings, and the uneven bedding seen in the Reading Beds, although partly due to current-bedding, is largely caused by irregular underground dissolution of the underlying Chalk.

Mr. Monckton gave an account of the geological history of the district. He said that he agreed with Prestwich in thinking the gravel on this and neighbouring high ground to be distinct from the glacial gravel, and he thought that earth-movements had taken place to a considerable extent since its deposition, this patch and also those on the neighbouring Eocene outliers most probably owing their preservation to the fact that they lay on the line of a slight synclinal flexure. He doubted the marine origin of the gravel, thinking it possible that it might be the earliest gravel of the River Thames.

Mr. Hopkinson stated that this was one of several outliers which extended from Albury near Bishop's Stortford, on the north-east, to beyond High Wycombe on the south-west, very nearly in a straight line parallel with the line of outcrop of the Reading Beds, with a few smaller and more distant outliers, and with inliers of these beds within the main mass of the London Clay, as at Pinner and Northaw; his inference being that the underlying Chalk had undergone a series of slight folds in parallel lines in this direction. He estimated the thickness of the Reading Beds shown in these sections as 16 feet, their total thickness here as from 25 to 30 feet. The outlier, he said, extended from Ayot Green, which was chiefly upon it, to Ayot St. Peter's Church on the north-west, and nearly to Digswell Church on the north-east, and covered an area of about two square miles.

Leaving the brickfields the party walked through Sherrards Park Wood and across the fields, which not long ago were the Woodhall Woods, and are marked as such on the original (1834) Ordnance Survey Map, to a large gravel-pit on the east side of the main line of the Great Northern Railway, near Woodhall Lodge Farm. The gravel is of glacial origin, and the chief interest of the section lies in the occurrence of two beds of

boulder-clay, one in a thick bed of gravel and the other at the surface of the ground, showing that, whatever may have been the manner in which the boulder-clay and gravel were deposited, they are very closely connected with one another. This large excavation is now being filled in with rubbish.

The party then walked to Hatfield, and on the way, just south of the River Lea, a disused brickfield was pointed out, from which Prestwich drew his section* across the valley of the Lea to Ayot Green, but there was not time to visit it.

Tea was provided at the "Salisbury Arms," Hatfield, after which, on the proposition of the President of the Geologists' Association, Mr. R. S. Herries, a vote of thanks was accorded to the Directors. Hatfield Park was then visited by most of the party, by the kind permission of the Marquis of Salisbury. The Park was entered by the old gate near the Church and left by the new gate opposite the railway station.

Although the weather was fine in the afternoon, but gloomy, rain had been falling all the morning, and the roads were too muddy for cycling, so the party was not a numerous one.

Field Meeting, 9th June, 1906.

CROXLEY, RICKMANSWORTH.

The discovery of Palæolithic implements and of the remains of vertebrate animals in the pits of the Rickmansworth Gravel Company having recently been brought before the Society by Sir John Evans,† this meeting was arranged with the permission of the Company to enable our geological members to examine the pits under the direction of Mr. Vernon P. Kitchin, who has succeeded in finding a large number of implements in the gravel.

The pits are in Long Valley Wood, on the right-hand bank of the River Gade, from which they are distant about an eighth of a mile, and they show extensive sections of the fluviatile gravel.‡ This has been worked for a distance of about half a mile in a north-easterly direction. Interstratified with it are layers of sand and clay, and the total thickness of the alluvial deposits is from 20 to 30 feet. They rest on the Chalk in a very uneven manner, so that it is difficult to determine the height of their base, but it appears to average about 30 or 40 feet above the level of the existing river. This is a tributary of the Colne, which here flows from east to west, and is distant half a mile at the eastern and a quarter of a mile at the western extremity of the gravel in Long Valley Wood, and this gravel should rather be considered as part of the alluvial deposit of the Colne in Pleistocene times than of that of the Gade.

* 'Quart. Journ. Geol. Soc.,' vol. xlvi, p. 138.
† 'Transactions,' Vol. XIII, p. 65.
‡ This gravel is mapped as glacial by the Geological Survey.

MASS OF READING BEDS IN PALÆOLITHIC GRAVEL AT LONG VALLEY WOOD, CROXLEY, NEAR RICKMANSWORTH.

The gravel consists for the most part of water-worn flints, some completely rounded, others subangular, and also contains quartz and quartzose-pebbles. The layers of sand and clay and some peculiar black bands give it in many places a stratified appearance, but it is nowhere horizontal for any considerable distance, this conformation being accounted for in places by cross-bedding, but mostly being due, as in the Ayot sections, to irregular dissolution of the underlying Chalk.

The large number of Palæolithic implements which have been found in the gravel, occurring throughout it but most numerous near its base, constitute its most interesting feature. The molar of an elephant, most probably *Elephas antiquus*, has been found at a depth of 20 feet from the surface, and also a tusk, believed to be of the same species.

At the western end of the pits there is an interesting pyramidal heap of sand and clay containing several large Sarsen-stones, and composed of green, white, yellow, and chocolate-coloured sand, together with a band of mottled clay. (See Plate VII.) It has only recently been exposed, and the presence in a fluviatile gravel of a mass which could so easily be washed away is not easily explained. It was suggested that the large Sarsen-stones may have helped to prevent its destruction. From its constituents and its position directly on the Chalk, Mr. Hopkinson said that it must belong to the Reading Beds.

The party then visited the interesting old tythe-barn of the St. Albans Abbots adjoining Croxley Hall, which was shown to the members by Mr. Sansom, the present tenant, as also was the fine old parlour in the house itself. The manor of Croxley was held of the Cellarer of St. Albans by the family of Creke or Croke, whence the name Crokesley, modernised into Croxley. On the dissolution of the monasteries it came to the Crown, and eventually it was granted by Queen Elizabeth to her physician, Dr. Kaye, who is better known under the Latinized form of his name, "Caius." He erected Gonville Hall into a College, and the Master, Fellows, and Scholars of Caius College are still Lords of the Manor.

Croxley Hall is "a good example of an old farm house, with gabled ends, and porch without; and within, solid beams overhead, with carved mantelpiece and panelled walls in the parlour." The tythe-barn adjoining is "about thirty-eight yards long, and very wide and lofty, and the largest cart-load of wheat which it is possible for the agricultural heart to conceive can pass in safety through its capacious north transept. The massive oaken posts, beams, and rafters, support a roof of tiles, which, if laid out, would perhaps cover an acre of ground. The outer face of the walls has been so often restored that all trace of the original work has been lost; but the timber and the roughly-carved Totternhoe Stone within, clearly indicate the building to be at least four centuries old." (Cussans, 'History of Hertfordshire,' Cassio Hundred, p. 130.)

This interesting meeting was concluded with tea at Croxley Green, in the orchard of the "Artichoke Inn," where, on the proposition of the President of the Society, a vote of thanks was passed to the Director.

Field Meeting, 16th June, 1906.

ROTHAMSTED, HARPENDEN.

The members assembled at Harpenden Station and walked to the Rothamsted Experimental Station, the meeting being under the direction of the President, Dr. Morison.

Mr. A. D. Hall, Director of the Experimental Station, which is now under the administration of the Rothamsted Agricultural Trust, conducted the party round the plots, on which are grown crops with different treatment as to manuring, etc., explaining the methods adopted and stating the results obtained. Wheat, barley, and other crops, and permanent grass, were observed under different courses of treatment, the effect of various kinds of manure on the growth of grass being specially interesting. Experiments were commenced in the year 1843, but it was not until 1856 that those on permanent grass-land in Rothamsted Park began, fifty years of experimenting on this having been completed in 1905. The plots present a very varied appearance now, and their produce of hay differs greatly both in quantity and quality. The quantity of hay yielded by plots treated with mixed mineral manure is from some of them as much as three and a half times as great as that from plots which have not had any manure for half a century, but the quality with this heavy yield is not equal to that from plots to which farm-yard manure has been applied. Treatment with nitrate of soda alone has been found to produce a great quantity of rank grass with an entire absence of clover, but though it should not be used alone, good results are given by nitrate or ammonia with potash and phosphate, while it has been found to be still better to use this mixture alternately with farm-yard manure.

The rain-gauges and percolation-gauges were also inspected, the latter, although designed to enable the chemical ingredients of rain-water passing through the soil to be ascertained, rather than the quantity of rain-water, having furnished some valuable information on the proportion which the percolation of water through various thicknesses of soil bears to the total amount of rain that falls. These gauges are, however, purposely kept with the surface of the soil in an artificial state, not having grass nor any crop growing on it, and even being frequently hoed to keep it free from weeds. Consequently the proportion of the rain which percolates is much greater than it is under natural conditions, when growing vegetation absorbs much water.

After cordially thanking Mr. Hall for his kindness in taking them round the experimental plots and explaining the treatment

to which they are subjected, the members proceeded, some by rail from Harpenden and others cycling, to St. Albans, where they were hospitably entertained at tea by the President and Mrs. Morison at their residence, Thirlestane.

FIELD MEETING, 7TH JULY, 1906.

BERKHAMSTED.

A numerous party assembled at Berkhamsted Castle, some having come by train from various parts of the county, but the majority consisting of cyclists, chiefly from Watford and St. Albans. Mr. Edward Mawley acted as Director, conducted the members round the ruins, and read an interesting paper by Mr. Montgomerie giving an account of the foundation of the Castle and of the results of excavations carried on for three years, being at first under the auspices of the Rev. Canon Norman and Mr. William Page, and subsequently under his own direction. This paper will be found in the present volume of our 'Transactions' (pp. 195–198).

Nothing but a few outer walls of flint-rubble now remains of the Castle in which Edward the Third and the Black Prince held their Court, and which was besieged by Louis of France in the reign of King John, all the available stone having been removed for building purposes, but the foundations of several towers and other buildings have been discovered in these excavations, with those of the south gateway facing the town in a line with Castle Street, and a chapel on the west side. A pavement of encaustic tiles has also been found.

The party then visited the Parish Church of St. Peter, where the Rector, the Rev. H. Constable Curtis, explained the features of interest in the building and its associations with notable persons, from the Black Prince, one of whose Esquires, John Raven, was buried here, to the poet Cowper, to whom there is a memorial window at the west end. The Church was built in the thirteenth century, though indications of earlier work have been traced. It was originally in the form of a Greek cross, the nave having subsequently been lengthened, and chantry chapels having been added on both sides of the chancel, one of which, dedicated to St. Catherine, is now used for daily service. There was also a third chapel, St. John's, which has been thrown into the south aisle. It was once used by the boys of Berkhamsted Grammar School, but there are indications of its having at a more distant period been connected with the Knights Hospitallers of St. John. Many interesting tombs and memorials exist, including recumbent effigies of Sir Richard Torrington and his wife, which date from the fourteenth century.

The members then proceeded to Rosebank, the residence of Mr. and Mrs. Mawley, who very kindly entertained them at tea, after which they were conducted over the garden, chiefly devoted

to the growth of roses, now at their best. Amongst the numerous choice kinds which were pointed out was a beautiful and comparatively new variety named after Mrs. Mawley, who presented the ladies of the party with bouquets of the choicest blossoms.

Mr. Mawley is the Hon. Secretary of the National Rose Society; he is also well known for the meteorological investigations which he has carried on for some years at Berkhamsted, and previously at Croydon, and he is a past President of the Royal Meteorological Society. He exhibited and explained the construction and uses of his numerous meteorological instruments, by means of which careful observations are taken of the temperature of the air, in the shade, in the rays of the sun by day, and at night exposed to radiation, and also of the temperature at one foot and at two feet beneath the surface of the ground; of the rainfall and the amount which percolates through three feet of soil, in one gauge with grass growing on the surface and in another kept free from vegetation; of the duration of bright sunshine; of the force and direction of the wind; and of the pressure of the atmosphere, determined of course by readings of the barometer. Some observations are taken daily, at 9 a.m. or 9 p.m., some at both these hours, and some also at 3 p.m. Several instruments are self-registering, continuously recording pressure, temperature, rainfall, sunshine, and wind—both its direction and velocity.

The weather was perfect, and, owing to the arrangements made by Mr. and Mrs. Mawley, a very interesting and enjoyable afternoon was passed, the members on leaving cordially thanking their host and hostess for their kind attention and hospitality.

Conversazione at St. Albans, 13th November, 1906.

The President and Mrs. Morison received a party of between fifty and sixty members and friends at the Hertfordshire County Museum, the evening's entertainment being divided between music and science.

The musical programme included songs by Mrs. Finn, Miss Marie Rose, Mrs. F. T. Usher, and Mr. H. T. Carrington, and orchestral pieces by Mrs. A. E. Gibbs and Mr. Matthews (first violins), Master G. F. Usher (second violin), Mr. Ernest Bennett ('cello), and Mrs. F. T. Usher (piano).

Mr. James Saunders gave a lecture on the Echinoderms or "sea-urchins," graphically describing the structure and habits of these interesting Invertebrata. He said that their organs were arranged from the centre radially so that they could move in any direction and by their feelers and spines easily crawl along the sea-bed and creep up the perpendicular sides of submerged rocks. They had a high antiquity. Always covered more or less with spines, in the present day the spines were

more numerous than in past ages. The fossil forms in the Chalk were covered with four-sided plates, but now their plates are five-sided. Their spines were attached so early as the Chalk period by ball-and-socket joints, thus anticipating this mechanical appliance of the present day. Their wide distribution was then pointed out, and their great range in depth, from the surface to two thousand fathoms. In concluding his lecture Mr. Saunders said that by the study of recent forms we could interpret the events of the past, and in so doing we should not err, for the more closely we inspect the more fully do we find that there is a unity of design passing through the whole of the series of the creatures which lived in the past; and not only so but we must feel that the same creative energy was exercised in all ages.

Mr. Vernon P. Kitchin at a later period gave an illustration, by the aid of a collection of specimens, of the apparent development of the bronze celt.

During the evening the collections in the Museum were examined with much interest, and refreshments were served.

254TH ORDINARY MEETING, 4TH DECEMBER, 1906, AT WATFORD.

JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc., Assoc. Inst. C.E., in the Chair.

Mr. W. Percival Westell, F.R.H.S., was elected a Member of the Society.

Mr. Gregory Macalister Mathews, F.L.S., F.Z.S., M.B.O.U., The Mount, Langley Road, Watford; and Mr. Charles Dudley Nuttall, M.R.C.S., L.R.C.P., 13, London Road, St. Albans, were proposed for membership.

It was announced that the Barnet Natural History Society and Field Club had become affiliated to the Society.

The following lecture was delivered:—

"Nature Study." By Wilfred Mark Webb, F.L.S., Hon. Sec. Selborne Society.

The lecture was illustrated by lantern-slides.

255TH ORDINARY MEETING, 16TH JANUARY, 1907, AT ST. ALBANS.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

Mr. G. M. Mathews, F.L.S., and Mr. C. D. Nuttall, M.R.C.S., were elected Members of the Society.

Mr. Charles Goddard, Eastwood, Arkley, Barnet, was proposed for membership.

The following lecture was delivered :—

"Geological Photographs." By William Whitaker, B.A., F.R.S., F.G.S., Assoc. Inst. C.E.

The lecture was illustrated by a large number of lantern-slides from the collection of the Geological Photographs Committee of the British Association.

The Mayor of St. Albans (Mr. Henry Worssam) called attention to the fact that a grand Historical Pageant was to be held at St. Albans in June or July.

256TH ORDINARY MEETING, 29TH JANUARY, 1907, AT WATFORD.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

Mr. C. Goddard was elected a Member of the Society.

The following paper was read :—

"Hertfordshire Earthquakes: Records of Shocks which have been felt in the County from 1250 to 1905." By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc. Inst. C.E. (*Transactions*, Vol. XIII, pp. 141–172.)

A diagram was exhibited in illustration of the paper.

257TH ORDINARY MEETING, 6TH FEBRUARY, 1907, AT ST. ALBANS.

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

The following lecture was delivered :—

"Monkeys." By Frank Finn, B.A., F.Z.S., M.B.O.U.

The lecture was illustrated by lantern-slides.

258TH ORDINARY MEETING, 26TH FEBRUARY, 1907, AT WATFORD.

JOHN HOPKINSON, F.L.S., F.G.S., F.R.Met.Soc., Assoc. Inst. C.E., in the Chair.

Mr. Henry J. Tudschi Broadwood, Bone Hill, St. Albans; Mr. George B. Dodwell, Coniston, Langley Road, Watford; and Mr. John David Geddes, Bushey Grove, Watford, were proposed for membership of the Society.

The following lecture was delivered :—

"Among the Birds with a Camera in West Herts and West Cumberland." By William Bickerton, M.B.O.U.

The lecture was illustrated by lantern-slides, mostly from photographs taken by Mr. Bickerton.

32ND ANNIVERSARY MEETING, 12TH MARCH, 1907.
(AT WATFORD.)

JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S., President, in the Chair.

The Report of the Council for 1906, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address on "The Mystery of Matter." (*Transactions*, Vol. XIII, pp. 173–194.)

The following gentlemen were duly elected as the Officers and Council for the ensuing year:—

President.—The Rev. Canon A. Merle Norman, M.A., D.C.L., LL.D., F.R.S., F.L.S.

Vice-Presidents.—John Attfield, M.A., Ph.D., F.R.S., F.C.S., F.I.C.; B. Daydon Jackson, F.L.S., Sec. Linn. Soc.; Edward Mawley, F.R.Met.Soc., F.R.H.S., V.M.H.; John Morison, M.D., D.P.H., M.R.C.S., F.G.S.

Treasurer.—John Weall.

Honorary Secretaries.—A. E. Gibbs, F.L.S., F.R.H.S., F.E.S.; Arthur Sutton, Assoc. R.S.M.

Editor.—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.R.Met. Soc., Assoc. Inst. C.E., Sec. Ray Soc.

Librarian.—Daniel Hill, F.R.H.S.

Other Members.—William Bickerton, M.B.O.U.; W. R. Carter, B.A.; A. E. Ekins, F.C.S., F.I.C.; Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., F.R.S., etc.; Henry Kidner, F.G.S.; Vernon P. Kitchin, B.A., F.E.S.; G. W. Lamplugh, F.R.S., F.G.S.; Gregory M. Mathews, F.L.S., F.Z.S., M.B.O.U.; George P. Neele; James K. Riggall; the Right Hon. the Earl of Verulam; Henry J. Worssam.

The thanks of the Society were accorded to Dr. John Morison, F.G.S., retiring from the office of President; to Mr. Lewis Evans, F.S.A., retiring from the office of Vice-President; and to Mr. P. J. Barraud, F.E.S., Mr. A. E. Cox, M.R.C.S., and Dr. T. E. Lones, M.A., retiring from the Council.

REPORT OF THE COUNCIL FOR THE YEAR 1906.

Although the financial position of the Society still gives cause for anxiety, the Council is able to report that in regard to membership and the interest taken in the proceedings there is a slight improvement compared with recent years.

The policy of dividing the meetings between Watford and St. Albans has been continued with gratifying results, and several popular lectures have been given at both places during the year and have been well attended. A most interesting conversazione was held at the County Museum, St. Albans, on 13th November,

to inaugurate the work of the winter session, and this new feature in the proceedings was a marked success.

The Society has lost, by death and resignation, only three members during the year, and one corresponding member and six ordinary members have been elected. The census at the end of the years 1905 and 1906 was as follows:—

	1905.	1906.
Honorary Members	13	13
Corresponding Members	5	6
Life Members	44	42
Annual Subscribers	93	98
	155	159

Seven Ordinary Meetings, as well as the Anniversary Meeting and the conversazione, were held during the year, and the following lectures and papers were read or delivered:—

Jan. 9.—British Zoophytes; by G. E. Bullen.
—— Witches' Brooms; by James Saunders, A.L.S.
—— 29.—Wild Nature's Ways; by Richard Kearton, F.Z.S.
Feb. 12.—Geological Photographs; by W. Whitaker, B.A., F.R.S., F.G.S.
March 6.—Notes on Lepidoptera observed in Hertfordshire in the year 1905; by A. E. Gibbs, F.L.S., F.E.S.
—— Coleoptera new to the Hertfordshire Fauna; by G. E. Elliman and C. T. Gimmingham.
—— Land and Freshwater Mollusca observed near St. Albans; by G. E. Bullen.
—— Notes on Birds observed in Hertfordshire during the year 1905; by William Bickerton.
—— Albino Moles in Hertfordshire; by A. E. Gibbs, F.L.S.
—— 20.—Nature's Protection of Insect Life; by F. Enock, F.L.S.
—— 26.—Anniversary Address: Inorganic Evolution; by the President, John Morison, M.D., D.P.H., F.G.S.
April 2.—On a Recent Palæolithic Discovery near Rickmansworth; by Sir John Evans, K.C.B., D.C.L., LL.D., F.R.S., etc.
—— The Weather of the year 1905 in Hertfordshire; by John Hopkinson, F.L.S., F.R.Met.Soc., Assoc.Inst.C.E.
—— Report on Phenological Phenomena observed in Hertfordshire during the year 1904; by Edward Mawley, F.R.Met.Soc.
—— Ostracoda and Mollusca from the Alluvial Deposits at the Watford Gas Works; by John Hopkinson, F.L.S., F.G.S.
—— Report on the Conference of Delegates to the British Association in London in 1905; by John Hopkinson.
Dec. 4.—Nature Study; by Wilfred Mark Webb, F.L.S.

A visit was paid to the Natural History Museum, South Kensington, on 28th April, and five field meetings were held during the spring and summer, as follows:—

May 5.—Aldbury, Tring.
May 26.—Ayot Green and Hatfield.
June 9.—Croxley, Rickmansworth.
June 16.—Rothamsted, Harpenden.
July 7.—Berkhamsted.

The best thanks of the Society are due to Dr. Arthur Smith Woodward, F.R.S., Keeper of Geology at the Natural History Museum, to Mr. A. D. Hall, M.A., Director of the Rothamsted Experimental Station, to the President and Mrs. Morison, at

St. Albans, after the Rothamsted field meeting, and to Mr. and Mrs. Mawley, at Berkhamsted, for their kindness in receiving or entertaining the members at the above meetings; also to Dr. and Mrs. Morison for receiving and entertaining the members and friends at the conversazione, and to Mr. and Mrs. A. E. Gibbs for arranging the programme of music on that occasion.

The twelfth volume of the present series of the Society's 'Transactions' has been completed during the year by the issue of three parts containing 88 pages and one plate. The volume consists of 344 pages with 30 text-illustrations and 7 plates. To the topography of the county the only contribution in it is the third instalment of the Catalogue of Hertfordshire Maps, which comprises 40 pages with a folding plate. The meteorology and phenology of the county are treated of in seven papers, the usual annual reports; to the geology three are devoted, one on the gravels of Hertfordshire and two on Post-Pliocene beds temporarily exposed at Watford and near Hunton Bridge; on the botany there are two papers, one on climbing and twining plants in the South Midlands, the other on the rate of growth of two species of oak at Bayfordbury; and on the zoology there are twelve papers, three being the usual annual reports on our Lepidoptera, and four others being entomological, three the annual reports on our birds, one a review of Hertfordshire ornithology, and one on Hertfordshire Mammalia. A paper on a Neolithic celt is the only contribution to the archæology of the county. One of the Presidential Addresses is of local interest, adding to our knowledge of the early Hertfordshire naturalists. Of 32 papers in the volume there are thus 27 which give the results of local investigations. The 'Proceedings' cover a period of two years and a half (January, 1903, to July, 1905), and include the annual reports of the British Association Conferences of Delegates of the Corresponding Societies.

The Society is indebted to Mr. B. Daydon Jackson for a donation which more than covers the cost of illustrating his Address on the History of Botanic Illustration; to Mr. Vernon Kitchin for the block used for Plate IV; to Mr. Fordham for that used for Plate V; to Mr. Hopkinson for those used for Plates VI and VII; and to Sir John Evans, Mr. Lewis Evans, and Mr. Fordham for the figures in the text illustrating their papers.

The usual exchanges with other Societies have been made and several other works have been added to the library.

The Barnet Natural History Society and Field Club has become affiliated to the Society on terms approved by the Council, and it is hoped that co-operation with this young and vigorous organization and its energetic Secretary, Mr. C. G. Kiddell, will result in benefit to both Societies.

The Council regrets that, in order to meet the increasing deficit of recent years, it has been necessary to sell India stock held by the Society to the amount of £30, reducing the invested

INCOME AND EXPENDITURE FOR THE YEAR 1906.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Entrance Fees	3	0	0	By Balance, being amount overdrawn	11	7	1
„ Subscriptions for 1904	0	10	0	„ Printing 'Transactions'	35	4	0
„ „ „ 1905	0	10	0	„ Miscellaneous Printing	6	10	5
„ „ „ 1906	39	10	0	„ Expenses of Meetings	5	0	0
„ „ „ 1907	3	0	0	„ Loss on one Lecture at St. Albans (£1 16*s.*), less profit on one at Watford (2*s.*) and on one at St. Albans (15*s.*)	0	19	0
„ Sale of 'Transactions'	0	6	0	„ Library Expenses	3	4	10
„ Sale of printing paper	0	9	6	„ Salary of Assistant	5	0	0
„ Dividends on £130 India 3 per cent. Stock	3	18	0	„ Stationery	0	9	8
„ Sale of £30 India 3 per cent. Stock	27	11	0	„ Postages and Carriage of Parcels	9	12	2
„ Balance, being amount overdrawn	1	0	10	„ Fire Insurance Premium	0	12	6
				„ Cheque Books	0	4	2
				„ Power of Attorney for selling India 3 per cent. Stock	0	11	6
				„ Entrance Fee and Subscription returned	1	0	0
	£79	15	4		£79	15	4

Amount invested in £100 India 3 per cent. Stock, at cost . . . . . £99 4*s.* 6*d.*

Audited and found correct this 8th day of March, 1907, { W. LEPARD SMITH. W. R. CARTER.

funds to £100. Even this leaves a small adverse balance, but arrangements have been made by which considerable economies will be effected, and it is hoped that it will be found possible in the future to meet all expenses out of current income.

The Society is very greatly indebted to the Watford Urban District Council for the free use of their Council Chamber for evening meetings, and of the old Board Room for the accommodation of the library; also to the Committee of the Hertfordshire County Museum for the use of the Museum for evening meetings and for the conversazione.

Additions to the Library.

Presented.

Geological Survey of the United Kingdom. Summary of Progress for the year 1905. 8vo. London, 1906 .	*The Association.*
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259TH ORDINARY MEETING, 23RD APRIL, 1907, AT WATFORD.

EDWARD MAWLEY, F.R.Met.Soc., F.R.H.S., V.M.H., Vice-President, in the Chair.

Mr. H. J. T. Broadwood, Mr. G. B. Dodwell, and Mr. J. D. Geddes were elected Members of the Society.

Mr. Claude Batley, Clarendon Chambers, Watford, was proposed for membership.

The following papers were read :—

1. "The Weather of the year 1906 in Hertfordshire." By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E. (*Transactions*, Vol. XIII, pp. 221–240.)

A diagram was exhibited in illustration of the paper.

2. "Report on Phenological Phenomena observed in Hertfordshire during the year 1906." By Edward Mawley, F.R.Met. Soc., F.R.H.S. (*Transactions*, Vol. XIII, pp. 241–248.)

3. "Notes on Lepidoptera observed in Hertfordshire in the year 1906." By A. E. Gibbs, F.L.S., F.R.H.S., F.E.S. (*Transactions*, Vol. XIII, pp. 199–204.)

4. "A List of Hertfordshire Diptera." By A. E. Gibbs, F.L.S., F.E.S., and Philip J. Barraud, F.E.S. (*Transactions*, Vol. XIII, pp. 249–276.)

5. "Notes on Birds observed in Hertfordshire during the year 1906." By William Bickerton, M.B.O.U. (*Transactions*, Vol. XIII, pp. 205–220.)

6. "REPORT ON THE CONFERENCE OF DELEGATES TO THE BRITISH ASSOCIATION AT YORK IN 1906." By John Hopkinson, F.L.S., F.G.S., etc.

The Conference met on the 2nd and 7th of August, the Chairman, Sir Edward Brabrook, C.B., presiding at the first meeting, and the Vice-Chairman, your Delegate, who contributes this report, at the second. The following members of our Society, amongst others, represented the Corresponding Societies Committee :—Dr. H. R. Mill, Mr. F. W. Rudler (Secretary), Mr. W. Whitaker, F.R.S. (Chairman of the Committee), and your Delegate.

FIRST MEETING.

In the Report of the Corresponding Societies Committee the names of thirty Societies were given as having been admitted as Associated Societies under the new rules, the Watford Camera Club, represented by your Delegate, being one of them; also the names of eight admitted as Affiliated Societies, bringing up the number of these to eighty.

The question of reduced railway fares for the members of the Corresponding Societies had received much attention by the Committee, but the only practical result was that the Council, on

the recommendation of the Committee, had authorized the issue, to all Corresponding Societies who send Delegates to the Annual Conference, of a form of warrant certifying that such Societies are recommended by the Council as suitable applicants for any privileged tickets which the Railway Companies may grant. The warrants can be obtained at the Office of the Association.

The subjects selected for discussion at the present Conference were "Meteorological Observations by Local Scientific Societies" and the "Desirability of promoting County Photographic Surveys." Both these subjects were suggested by your Delegate, the first on behalf of the Hertfordshire Natural History Society and the second on behalf of the Watford Camera Club.

The Chairman, Sir Edward Brabrook, stated that this was the first Conference at which Associated as well as Affiliated Societies were represented, and he anticipated great advantage from the new departure, alike to the Societies which are here brought into union and to the Association.

In 1892, when these Conferences had been held for eight years under the management of the Corresponding Societies Committee, he required information as to what the local Societies had done for anthropology, and he found from that Committee's reports that thirty-three local Societies had been engaged in valuable, original, anthropological work, and that at least one hundred individuals had contributed anthropological papers to their Societies. They occupied the whole country from Penzance to Inverness and from Rochester to Belfast.

Local work connected with three Sections of the Association, (F) Economic Science, (H) Anthropology, and (L) Education, was then dealt with, and it was shown that each of these subjects should be studied in relation to local conditions; thus each locality had its own ancient monuments, past history, and mixed population with special racial affinities; its own ancient customs, folklore, dialect, and place-names; and thus every local Society was interested in working out its own anthropology. So also should education be carried on with a view to the requirements of each locality, boys in a seaport town being taught seamanship, in a business town bookkeeping, in a manufacturing town mechanics, and in an agricultural district chemistry. And to attain this the best educational authorities would be found among the scientific men of the locality.

The Chairman then said that in affiliation and association of local Societies the sinking of their individual character was not included, but there was much which this Conference could do within its legitimate province, and he concluded his Address as follows:—"In the free communication with each other which is here set up, in the discussion of methods of working, in pointing out special subjects in which definite and organized investigation is desirable, in learning what has been done by such and such a Society so as to avoid wasteful duplication and repetition of work, there is ample material for conference. In the excellent

relations which such meetings as these create between those who are engaged in the like pursuits and are actuated by the same ambitions there is an element of great value. 'Iron sharpeneth iron; so a man sharpeneth the countenance of his friend.' We who are now admitted to be your associates,* whose highest claim is that our Societies are 'formed for the purpose of encouraging the study of science,' will leave this Conference, I am persuaded, more than ever stimulated to do our utmost to fulfil that purpose."

Dr. H. R. Mill then introduced the subject of "Local Societies and Meteorology."

The study of meteorology might, he said, be commended to the attention of those scientific Societies whose scope is wide, on account of the means it affords of advancing science and at the same time obtaining those intellectual advantages to the student which it is one of the objects of scientific Societies to secure. The best advice which could be given to an enthusiast anxious to observe was not to begin until he had good instruments certified as accurate. In a long record the difference between the cost of good and bad instruments was almost nothing compared with the value of the observer's time, for a few shillings spent or saved might make all the difference between results of permanent value or useless or even harmful results.

There was scope in meteorology for a great diversity of work. At present the most interesting and perhaps the most important definite research was the investigation of the free air at great heights by means of instruments raised by kites. Another research which awaited the student was that of the measurement of moisture in the air, and the revision of the tables by means of which the humidity was calculated from readings of the dry and wet bulb thermometers.

In the study of local climate co-operation of local Societies might be confidently invited. Every important town should have a properly equipped meteorological station. The climate of a place could only be determined by a long record, and if such a record were under the charge of a Society it should go on continuously, ever growing in value. Anyone wishing to start such a station would find full particulars clearly set forth in Mr. W. Marriott's 'Hints to Meteorological Observers,' published by the authority of the Royal Meteorological Society (Stanford, 1*s.* 6*d.*). That Society was always ready to encourage the study of meteorology, and had recently made arrangements to co-operate with local Societies by providing lectures and exhibitions of instruments, full particulars of which might be obtained from the Secretaries at 70, Victoria Street, London, S.W.

Two elements of climate were mentioned as needing additional study—sunshine and rainfall. The duration of sunshine should be measured by the Campbell-Stokes sunshine-recorder, and the

* Sir Edward Brabrook represented an *Associated* Society.

records should be sent either to the Meteorological Office or to the Royal Meteorological Society for accurate measurement and preservation. A few hundred stations uniformly distributed over the country would supply all the information necessary with regard to temperature, pressure, and wind, but the influence of local conditions upon rainfall necessitated several thousand well-distributed stations. The 4,000 rainfall stations now at work in the British Isles were not uniformly distributed. The districts in which additional rainfall stations are most urgently required were stated to be the Highlands of Scotland, the West of Ireland, and the East and North Ridings of Yorkshire.

It was desirable that all rainfall observers should be in touch with the British Rainfall Organization under the direction of the speaker at 62, Camden Square, London, W., but there was room for local associations of observers, of which the following were mentioned as supervising rainfall stations and publishing the records, apart from the stations provided by the Meteorological Office, the Royal Meteorological Society, and the Scottish Meteorological Society:—

Croydon Natural History Society.—102 stations in north-western Kent and eastern Surrey.

Dorset Field Club.—48 stations in Dorsetshire.

Hertfordshire Natural History Society.—54 stations in Hertfordshire.

Northamptonshire Natural History Society.—41 stations in Northamptonshire.

North Devon Athenæum (Barnstaple).—30 stations in North Devon and Somerset.

Also by individuals in Norfolk, Cambridgeshire and Huntingdonshire, Mid-Wessex, the English Lake District, the Isle of Man, and Stirlingshire.

Mr. J. Ferguson (Ceylon) inquired what period Dr. Mill would fix as the minimum for continuous rainfall observations to prove of practical value, and pointed out the importance of experience in simple meteorological observations to young men who looked for a career to farming or planting in the Colonies.

Your Delegate said that he feared some might be deterred from taking meteorological observations by thinking that the cost of the instruments was greater than is really the case. A reliable "Snowdon" copper rain-gauge with a certificate from Dr. Mill or from the Kew Observatory might be obtained for 20*s.* or 21*s.* For a Climatological Station of the Royal Meteorological Society four thermometers were also required (a maximum and minimum and a dry and wet bulb), and a "Stevenson" screen to place them in, the cost of the entire equipment being, he thought, about £6.* All the thermometers should be tested at the Kew Observatory. Only one daily

* Mr. J. J. Hicks, of 8, Hatton Garden, will supply the whole equipment, including certificates for all the instruments and supports for the Stevenson screen, for this sum.

reading was required (at 9 a.m.), when the proportion of sky covered by cloud (0–10) should be estimated. He knew from experience that all the observations required for such a station *could* be made in five minutes. Continuity was most important, and he would urge upon the Corresponding Societies to endeavour to ensure continuity of observation by getting any private meteorological observatory which seemed likely to be discontinued transferred to some institution or public body. After taking meteorological observations for twelve years at Watford and for thirteen years at St. Albans, on removing from there to return to Watford, he transferred his own instruments to the County Museum at St. Albans, instructing the caretaker of the Museum how to take the observations, which he worked up and published annually in the 'Transactions' of his Society. As the Climatological Station thus established was vested in the Hertfordshire County Council, he hoped that it would be permanent.

Dr. J. R. Ashdale, of Rochdale, suggested that meteorological work might be promoted by carrying out a meteorological survey of the British Isles, each local Society being asked to fill up a schedule stating what observations were being taken in its own area, the instruments used, when and how verified, the duration of the record, and where the results were published. Attention should then be drawn to those districts where records were non-existent or scanty, and an endeavour should be made to make good the deficiencies.

Mr. N. H. Martin, of Newcastle-on-Tyne, said that meteorological observations should be undertaken by local scientific Societies in order to secure their continuity over a long series of years. He thought it was not so much the expense of fitting-up a station as the tie to read the instruments punctually which deterred private individuals from the work.

Dr. Mill, in his reply, said that while at least thirty years would be required in this country to determine the average rainfall, a much shorter period would suffice for the less variable climate of the tropics. The lists of meteorological stations published annually by the Meteorological Office, the two Meteorological Societies, and in his 'British Rainfall' fairly covered the ground, but it would be an advantage to have these reduced to a single list indicating the nature of the work done at each station. One daily reading of a rain-gauge, at 9 a.m., was all that was asked for, but weekly or even monthly readings were not without value in certain circumstances.

SECOND MEETING.

The Chairman, your Delegate, said that it might not be known to all who were present that a Conference of Delegates of Corresponding Societies met at York twenty-five years ago. It was not recorded in the Reports of the British Association;

for, although held under the sanction of the Council, it was not an official department of the Association. It was the second of five unofficial Conferences due to his suggestion at Sheffield in 1879, the first having been held at Swansea in 1880 and the last at Montreal in 1884. Reports of these annual Conferences were printed and distributed to the Corresponding Societies, the Delegates or their Societies contributing to the expense of printing and postage, and abstracts of these reports—the only permanent record—appeared in the 'Transactions of the Hertfordshire Natural History Society' (Vol. VI, pp. 45–47). He wished to impress upon all the Delegates that they were expected to give a report, however brief, of the present Conference to the Societies they represented, and to obtain its publication by their Societies. They were asked to do this in the circulars issued by the Corresponding Societies Committee, but he believed that only a few Delegates complied with this request.

At this meeting suggestions for a photographic survey of the Counties of Great Britain and Ireland would be brought before the Conference by Mr. W. J. Harrison, and he thought that all would admit that this was an important subject, and one which well deserved the consideration of our County Societies. It was becoming more and more desirable that a permanent representation should be obtained of the interesting features of our country, whether natural or the work of man; for at no former period had the destruction or mutilation of such features been more rife, and never before had so much interest been taken in their preservation. This apparent paradox might be explained by the fact that the greater the vandalism the greater was the protest it evoked. Nor should the ravages of time be overlooked, nor the changes due to natural agencies, such as the encroachment of the sea upon our coasts. The sooner the better, therefore, would it be for a systematic attempt to be made to obtain and preserve a picture of everything of interest admitting of representation by the camera in all departments of science not within the scope of any existing Committee of the Association. This could best be done by our Natural History and Archæological Societies, our Camera Clubs and Photographic Societies, and our amateur photographers unattached to any Society or Club, working in conjunction with some central body, such as a Committee of the British Association; for in this way only could a photographic survey be sufficiently systematic in its execution, and comparable results of value be achieved.

In the absence of Mr. Harrison the paper by him on "The Desirability of promoting County Photographic Surveys" was read by the Secretary.

This was an elaborate paper, filling rather more than six pages in the report of this Conference in the annual volume of the British Association. Only a brief summary of the contents can here be given, and the paper should be read in its entirety by anyone about to take up photo-survey work. It consists of the

following six divisions:—(1) Origin of the Photo-Survey Movement; (2) Progress of Photo-Survey Work in Britain; (3) Objects of Photo-Survey Work; (4) District Surveys and Subject Surveys; (5) Base of the British Photo-Survey; (6) Promotion of the Survey Movement; and also an Appendix of Suggestions and Memoranda for the use of Societies, Committees, or Sections as to the working of a Photographic Survey.

(1) The photo-survey movement originated in a note upon "The Work of a Local Photographic Society," read before the Birmingham Photographic Society in 1883, and published in the 'Photographic News' (vol. xix, p. 421). This eventually led to an attempt to link together the photographers of the world, a paper on the subject being read at the World's Congress at Chicago in 1893.

(2) A paper read at Birmingham in 1889, entitled "Notes upon a Proposed Photographic Survey of Warwickshire," has resulted in an annual exhibition of local photographs in the Municipal Art Galleries of Birmingham, the prints being afterwards deposited in the reference department of the Birmingham Free Libraries, where they now number 3,020 prints in 110 folio volumes. A list of other localities and of a few counties where similar work is carried on was given.

(3) The chief objects of photo-survey work are to benefit (*a*) the individual photographer, (*b*) the scientific and photographic Societies, and (*c*) the nation generally.

(*a*) By giving the photographer an object, causing him to learn much about the objects photographed and bringing him into contact with experts who will afford him information.

(*b*) By bringing members of Societies together, attracting members, and bringing the Societies before the public. Members of local Societies can show photographers what to photograph.

(*c*) By recording the present physical features of the land, the present state of buildings and monuments, and the present life of the nation—the trades, dress, occupations, habits, and amusements of the people. This would afford valuable information, showing in course of time the changes which occur.

(4) A District Survey is one in which all items of interest in a definite area are photographed; a Subject Survey is one in which some definite line of research is followed, such as those undertaken by the Geological Photographs, Anthropological Photographs, and Botanical Photographs Committees of the British Association, this Association being specially well fitted to carry on the work of subject surveys.

(5) The unit for district surveys should be the county; the maps those of the Ordnance Survey, the one-inch or the six-inch (to the mile), preferably the latter as the detail given enables the orientation of buildings to be determined and therefore the time of day when the light will be best for the purpose.

(6) The appointment of a Committee was suggested:

(*a*) To collect details as to the work done or being done.

(*b*) To prepare and circulate printed matter on the work of the survey so as to make its aims and methods known.

(*c*) To co-ordinate the photographic with the literary and scientific Societies so that all may unite in the work.

(*d*) To obtain lists of experts who would be willing to advise upon special subjects; to draw up county lists of objects and places with their points of interest; to write descriptions of the prints; and to compile lists of county literature.

(*e*) The publication of series of prints, either of districts or subjects, would popularize the survey.

The Appendix gives in 28 sections details of working. Prints should *preferably* be *permanent*; they may be of any size, half-plate or whole-plate being preferred; if mounted they should be on standard mounts, 14 ins. by 11 ins. to take one whole-plate, two half-plates, or four quarter-plates, the mounts being cut-out so as to protect the prints from abrasion. Examples were given of areas to be surveyed and of special lines of enquiry; methods of working the survey were suggested; and a description was given of a set of apparatus used for survey-work for several years (presumably by the author of the paper).

A long discussion followed, in the course of which it was elicited that there were several county surveys in progress besides those mentioned by Mr. Harrison, but that there was a want of uniformity which could best be overcome by the appointment of an Advisory Committee, and the Chairman proposed that an application should be made at next year's meeting of the British Association to secure the appointment of a Committee for County Photographic Surveys, which was approved, members of such a Committee being nominated.

Reports from the Sectional Committees were then taken.

Section A (*Mathematics and Physics*).—Observations of solar radiation and of the brightness of the sky at night were suggested as new work for local Societies.

Section E (*Geography*).—Attention was called to the work of the Committee appointed for investigating the quantity and composition of rainfall and of lake and river discharge.

Section H (*Anthropology*).—Co-operation was asked for in the work of a Committee formed by this Section in conjunction with the Anthropological Institute to collect and register anthropological photographs; and also with a Committee appointed to report upon the best means of registering the megalithic monuments of Great Britain. Photographs of rude stone monuments and hut-circles were, it was stated, much needed. The Delegates, being asked to appoint a member of this Committee, nominated the Secretary of the Conference, Mr. Rudler, to serve on it.

FIELD MEETING, 6TH APRIL, 1907.

BUSHEY AND CROXLEY.

This meeting was held in conjunction with the Geologists' Association, Mr. Hopkinson and Mr. Henry Kidner acting as the Directors for both Societies. Bushey Railway Station was the place of meeting. Here a cutting through the Reading Beds, which are 35 feet in thickness, terminates. Proceeding along the top of the cutting on its western side a "trial hole" was seen. It has been made in order to ascertain the nature of the strata to be encountered in constructing the proposed electric line to Watford, and shows a fine light-coloured sand.

Crossing the bridge over this cutting, Grover's brickfield in Lower Paddock Road was visited. In it was seen a bed of pebbles and sand of the Reading Series, partly converted into a conglomerate, the exposure being, in fact, the best section of the Hertfordshire conglomerate or "plum-pudding stone" now to be seen in the county. It is about 3 feet thick, and lies upon light-coloured sand seen for a depth of nearly 4 feet. On a level with these beds were seen the clays of the higher part of the Reading Series and the basement-bed of the London Clay with its thin band of flint-pebbles at the top. It appears to be most probable that this indicates a north and south fault with a downthrow of 7 or 8 feet on the east, the fault having its origin in the chalk below. The brickfield has not been worked for some time and is now being filled in with refuse, and on the insanitary soil thus formed, houses will probably before long be built.

The Bushey Chalk Pit, near the Colne Valley Water Works, was next visited. The section of Upper Chalk and overlying beds exposed has been described in accounts of previous visits. On this occasion several fossils were found in the Chalk, and the view expressed by Mr. Jukes-Browne in the 3rd volume of his 'Cretaceous Rocks of Britain' (Mem. Geol. Survey), that this pit is more probably in the zone of *Micraster coranguinum* than in that of *M. cortestudinarium*, was confirmed.

The following is a list of fossils found in the pit, mostly in the lower part, including a few from the cutting towards the Watford tunnel. It is compiled from one in the work referred to above (pp. 233–234), a list sent to the writer by Mr. C. P. Chatwin and Mr. T. H. Withers and published in the 'Proceedings of the Geologists' Association' (vol. xx, p. 95), and other records there given for this pit.

Foraminifera. — Crystallaria rotulata, Lituola nautiloides, Webbina sp.

Spongida. — Porosphæra globularis, Thamnospongia sp., Ventriculites impressus.

Actinozoa.—Parasmilia sp.

Echinodermata.—Bourgueticrinus ellipticus, Cidaris clavigera, C. perornata, C. sceptifera, C. subvesiculosa, Echinocorys scutatus,

Epiaster gibbus, Galerites albogalerus, Micraster coranguinum, M. cortestudinarium, Oriaster sp.

Annelida.—Serpula plana, S. proteus?

Polyzoa.—Alecto (Stomatopora) sp., Bicavia dilatata, Crisina subgracilis, Diastopora sp., Domopora clavula, Entalophora clavata? (echinata), E. obliqua (Clausa heteropora), E. raripora (virgula), Eschara sp., Flustrellaria (Onychosella) granulosa, Hippothoa sp., Homœosolen ramulosus, Membranipora sp., Proboscina ramosa, Sparsicava carentina, Truncatula alternata, Vincularia sp.

Brachiopoda.—Crania egnabergensis, Kingena lima, Megathyris (Argiope) megatrema, Plicatula sigillina, Rhynchonella plicatilis?, R. reedensis?, Terebratula semiglobosa, Terebratulina striata, Thecidium Wetherelli.

Lamellibranchiata.—Inoceramus involutus, Ostrea vesicularis, Pecten sp., Spondylus latus.

It will be seen from the number of genera of which species have been found which could not be determined, owing to the imperfect state of the specimens, that further research might result in a considerable addition to the number of known species.

From this pit the members of the two Societies made their way to Long Valley Wood, Croxley Green, some by train to Rickmansworth and others cycling. The gravel-pits here were visited in the previous year, and the account of the sections given in the report of that visit need not be repeated. The point of most interest was the method of preservation of the mass of Reading Beds there referred to. It had been preserved intact for the present visit so far as possible, but the large Sarsen-stones which were on the top had fallen down, and one of them had been removed to the County Museum, where it now stands on the right-hand side of the entrance; the clay above the sand, also, had shifted from the horizontal position in which it was first seen. One of the Sarsens is represented on Plate XI. It is about 5 feet long, and 2 ft. 6 ins. wide. The mass when first seen was about 6 feet in height and 10 in width, and the gravel was distinctly arched above it. The sand was stated by the foreman of the gravel-pits to go down at least 6 feet below the present level of the surface, which is here close to the Chalk. This seemed to indicate a "pipe" in the Chalk. The Sarsens were found to be soft in places; one was sharply split across, another was deeply mamillated.

A visit by the writer this summer (1908) showed that "piping" was the cause of the preservation of this patch of Reading Beds, and of the curvature of the stratum of gravel above it. It had been in a "pipe," but the chalk around it has been dissolved by carbonated water, which has not affected the Tertiary material. The gravel above it has therefore remained in the position in which it was deposited, but has sunk around it where resting on the Chalk, thus assuming an arched form. This explanation implies an enormous lapse of time since the

SARSEN STONE IN READING BEDS AT LONG VALLEY WOOD, RICKMANSWORTH.

deposition of the Palæolithic gravel, and therefore of the advent of man—a sufficiently long period for a depth of 6 feet of chalk to be removed by chemical dissolution.

The party returned to Watford for tea by the canal towing-path and the Rickmansworth Road.

FIELD MEETING, 13TH APRIL, 1907.

WHITCHURCH.

This meeting was held in conjunction with the Barnet Natural History Society, and was under the direction of Mr. Kiddell, Secretary of that Society, and Mr. Sutton.

Members of the Herts Society met at Stanmore Station and walked to Whitchurch, where they were met by others who cycled, and by members of the Barnet Society. The Parish Church of Little Stanmore, or Whitchurch, was then inspected.

The tower is in the Gothic style, and dates from the reign of Henry VIII, but the body of the old Church was pulled down and rebuilt by the Duke of Chandos in the year 1715. The ceiling and walls of the Church are covered with fine frescoes, mostly the work of the French artists Verrio and Laguerre, who came over to England especially to execute them. The fresco over the communion table, representing "The Adoration of Jehovah," is by Verrio. The pictures on each side of it are by Belluchi, and represent "The Adoration of the Shepherds" and "The Descent from the Cross." That on the ceiling over the gallery at the west end is a fine copy by Belluchi of Raphael's "Transfiguration."

In a recess behind the communion table, upheld by four pillars of oak from Canons Park (carved by Grinling Gibbons), stands the famous little organ upon which Handel played during the years 1718–21. It was built by a pupil of Father Schmidt, and was restored and enlarged by Brinley and Foster in 1877, but the case is the original one carved by Gibbons.

The stained-glass windows are modern, dating from the sixties, and represent some of Handel's greatest works. On the north side there is a small chapel containing marble monuments of the Dukes of Chandos and Buckingham.

The Church, which is dedicated to St. Lawrence, was restored in 1897, when a new communion table and oak screen were placed in it.

In the churchyard was seen the tombstone erected to the memory of William Powell, "The Harmonious Blacksmith," who was Parish Clerk when Handel was Organist.

On leaving this interesting Church some collecting was done in ponds on the green near, and then the party walked to Great Stanmore for tea, and thence to Harrow Weald Common on the way back to Watford.

Field Meeting, 27th April, 1907.

KING'S LANGLEY.

The members, under the direction of Mr. Sutton, assembled at King's Langley Church, which is interesting on account of its association with Edmund de Langley, fifth son of Edward III, who was buried here. The village owes its name to the fact that this king built a palace on the tract of fertile land known as the "lang-lea" or long pasture, on a spot still marked by a few fragments of ruins a little west of the Church, and the Royal Manor became known as Langley Regis. Edmund de Langley was born in this palace in 1344. He became Duke of York, Earl of Cambridge, and Lord Tivedale, and married Isabel, a younger daughter of Don Pedro of Castile. In 1392 Richard II, with his first Queen, Anne of Bohemia, kept Christmas at King's Langley Palace.

Near the Palace was founded, by one Roger Helle, a Priory of Dominican Monks, which was enriched by Edward II and several successive monarchs. The present Church is a Perpendicular structure of flints and Totternhoe Stone. The tomb of Edmund de Langley and Isabel of Castile, brought from the Priory Church at the Dissolution, formerly stood on the north side of the chancel, but is now in the chapel at the end of the north aisle. During the removal of the tomb to its present position the bones of a male and of two females were discovered, being presumably those of Edmund and Isabel, and of Anne Mortimer, the wife of Edmund's second son, Richard, Earl of Cambridge.

While the members were in the Church, heavy rain came on, and it did not cease the whole of the afternoon. On leaving they walked up the hill past the ruins of the reputed Palace, to see what remains of the Dominican Priory established in 1308, the portion of the building left being now known as the Priory Farm. Here the present tenants afforded the party a welcome shelter, and it was decided, on account of the continued rain, not to proceed to Chipperfield Common, as had been intended, but to return direct to Watford, some by train, others cycling.

Field Meeting, 11th May, 1907.

BEECH BOTTOM AND SANDRIDGE.

The members met at St. Peter's Church, St. Albans, where they were joined by members of the Barnet Natural History Society, and then, under the leadership of Mr. A. E. Gibbs, proceeded to Beech Bottom by way of Harpenden Road. Here, during the walk through this ancient earthwork to Soot House Lane, Mr. Gibbs gave an account of the views held as to its origin, which have been stated in reports of former visits.

Some members of the party explored the Sandridge end of the earthwork, while others went to the Parish Church, where they were received by the Vicar, the Rev. H. R. Anson, and by Miss Anson. Here Mr. H. R. Wilton Hall gave an interesting address on the history and associations of the Church.

"Dr. Jessop," Mr. Wilton Hall remarked, "says that 'monks were rather robbers of churches than builders,' but in the case of Sandridge it was evident that but for the monks the Church could scarcely have existed, since there were never any great landowners here to take the initiative in such matters.

"The history of Sandridge is almost continuous with that of St. Alban's Abbey, the ville of Sandridge having been given to the Monastery within a few years of its foundation. There is no record of the earliest Church, but parts of the present building undoubtedly date back to Saxon times. The remains of the round-headed arch in the east wall of the nave is undoubtedly part of the Church which was consecrated in the twelfth century, within a year or two of the consecration of St. Alban's Abbey Church by Bishop Losinga, when it probably consisted of a nave with apsidal chancel, the entrance to the latter being by the narrow archway, in accordance with an arrangement similar to that still to be seen at Bengeo and Amwell.

"The first alteration to the Church seems to have taken place some time after 1150, when the present Norman arcades of the nave were built and the aisles added, the north door of the Church then probably having been removed from the older building to its present position. Some time in the Early English period (in the reign of Edward I), the western wall was rebuilt and the Early English archway into the tower inserted.

"It has been suggested that the monastery of St. Albans, from time to time, when there was no urgent need there for skilled workers, set them to work on some of their Parish Churches, and Sandridge has been noted as an example of this. If so, we have a finer specimen of Norman architecture in Sandridge Church than any of that period in the Abbey.

"Towards the end of the fourteenth century, at quite the beginning of the Perpendicular Period, the east wall of the nave was pierced to receive the present screen. Its bare appearance on the western side is owing to the fact that the rood-screen was of wood. About the year 1399 Abbot John de la Moote took down the chancel and rebuilt it in the style of the period, and about the same time the windows were altered to their present form.

"Nothing more appears to have been done of any structural importance whilst the Church was in the hands of St. Albans Abbey, its architectural history remaining a blank until towards the end of the seventeenth century. At that period, according to Salmon, the tower fell down, leaving the Early English arch exposed."

The later history of the Church, traced by Mr. Wilton Hall, does not fall within the province of our Society.

The Vicar and Miss Anson invited the party to tea, but the Barnet Society had made arrangements for tea elsewhere, so the party divided, the members of the Herts Society partaking of the hospitality of the Vicar and his daughter, after which they made a tour of the Vicarage grounds, tastefully laid out by the Rev. Dr. Griffiths, a former Vicar and an expert horticulturist.

Before leaving, thanks were accorded on the proposition of Dr. Morison to Mr. Wilton Hall for his address and to the Rev. H. R. Anson and Miss Anson for their kind reception and hospitality.

Field Meeting, 1st June, 1907.

RUISLIP RESERVOIR.

The members assembled at Northwood Station and thence took a field-path to the Reservoir in order to collect microscopic objects in conjunction with members of the Quekett Microscopical Club, and under the direction of Mr. D. J. Scourfield. A good opportunity was thus afforded of learning the best methods of collecting pond-life, and many interesting objects were obtained.

Soon, however, after the collecting had begun, a thunderstorm came on, and much time was lost in sheltering from the rain. In fact, as it continued persistently no more could be done, and after having tea, home was made for. Seldom has a party of cyclists had such a drenching as those who rode back to Watford through the storm, to find the heavy rain cease just as they arrived home.

Field Meeting, 8th June, 1907.

BERKHAMSTED AND ASHRIDGE PARK.

This meeting was held by invitation of the President, the Rev. Canon A. M. Norman, F.R.S. For those members who did not cycle or motor, Canon Norman provided a brake from Berkhamsted Station to Messrs. Lane & Son's Nurseries on the Common, and thence to Ashridge House, where, by kind permission of Earl Brownlow, the chapel and gardens were visited.

The rhododendrons, for which the gardens of Ashridge are famed, were in the height of their glory, presenting a gorgeous effect of massed colour, which, for brilliancy and variety of hue, can hardly be surpassed.

On their return to Berkhamsted the members were kindly entertained at tea by Canon Norman, at his residence, The Red House, where they afterwards rambled through his garden and inspected portions of his extensive private museum of

marine zoology. The Canon is one of our greatest authorities on this subject, having spent the greater part of a long and active life in the study of animal life in the sea.

Before leaving, a vote of thanks was accorded to the President on the proposition of Mr. Hopkinson for his hospitality and the very pleasant and instructive afternoon the members of the Society had spent under his charge.

FIELD MEETING, 15TH JUNE, 1907.

ALDBURY AND IVINGHOE.

This was a joint meeting with the Geologists' Association, held under the direction of Mr. Henry Kidner, F.G.S. Owing to heavy rain in the morning it was but sparsely attended. A waggonette was waiting for a party of nine at Tring Station, and one member, the writer, joined later, cycling.

Proceeding by way of Aldbury the steep road to the right was ascended past a disused pit in the Middle Chalk (*Terebratulina* zone) and on to Aldbury Common, where Mr. Ashby's brickfield was visited. This is an outlier of the Reading Beds which here appear to have been much disturbed. Above them is brick-earth for which the pit is chiefly worked. This is seen along the top of the pit as a thick, irregular deposit of clay full of angular pieces of flint with many pebbles of flint and a few of quartz. A hole recently dug in one corner has resulted in the discovery of a mass of clay 12 to 14 feet thick, brilliantly coloured in various shades of purple, red, and green. Near the top was an oval-shaped mass of fine, pale sand, suggestive of its having been thrust into the clay while in a frozen condition. Large flints were found in the lower part of the clay, and extending through the mass in two places were irregularly-contorted layers of flint-pebbles, having the appearance of Tertiary pebble-beds squeezed by lateral pressure. Much sand was seen amongst the clay. The Reading Beds appear to have been disturbed by glacial action rather than deposited by ice.

This is one of a series of five small Tertiary outliers which run parallel with the outcrop of the main mass on the northern margin of the London Basin; and the next one, at Ringshall, was passed on the way to Ivinghoe Beacon. The summit of the Beacon Hill, 762 feet above mean sea-level (about 50 feet lower than the highest part of the ground which had been passed over from Ringshall), is in the Upper Chalk, in the *Holaster planus* zone, just above the Chalk Rock. The view over the Gault plain with the Lower Greensand hills in the distance was interfered with by heavy rain in gusts of wind, which ceased soon after our descent.

Near Ivinghoe a pit in the Lower Chalk was well worked for fossils, and the zonal index-fossil, *Holaster subglobosus*, and *Terebratulina gracilis*, were found; also a "rag" bed full of

fish-remains — teeth, scales, and pieces of bone. Its green-coated nodules are much less phosphatic than are those of the Cambridge Greensand. A fault in the pit is well shown by this bed being thrown down to the right, and a slanting streak of crushed chalk clearly indicates the line of fault.

A chalk-pit under Pitstone Hill was next examined. Here the junction of the Lower and Middle Chalk is well shown, with the two *Belemnitella* marly bands separated by hard white chalk (3 feet in all), forming the top of the Lower Chalk. In these beds the characteristic fossil *Actinocamax plenus* was found, and also *Ostrea vesicularis*. The hard, massive, nodular Melbourne Rock, forming the base of the Middle Chalk, was seen above the marly bands, and in and above it several specimens of the zonal index-fossil, *Rhynchonella Cuvieri*, were collected.

A little farther on, on the opposite (right-hand) side of the road, near Folly Farm, there is a pit in the *Rhynchonella Cuvieri* zone, with this species common, and *Inoceramus mytiloides* abundant, though mostly in fragments. Both these species were found on this visit. Mr. Kidner has also collected from this pit *Conulus* (*Echinococcus*) *sub-rotundatus*, *Discoidea Dixoni*, *Inoceramus latus*, *Terebratula biplicata*, *Camerospongia sub-rotundata*, and *Ventriculites* sp.

On arriving at Tring Station tea was had at the Royal Hotel. Thanks were accorded to Mr. E. T. Newton, F.R.S., for identifying some of the fossils, and to Mr. Kidner for acting as Director. To his report to the Geologists' Association the Editor is indebted for most of the information here given.

Field Meeting, 22nd June, 1907.

REDBOURN AND AUBREY CAMP.

This meeting was held in conjunction with the Barnet Natural History Society, and was under the direction of Mr. C. G. Kiddell, the Secretary of that Society.

From the village the party traversed the avenue of fine old elms which extends the whole length of the common and leads to the Church, near which rise some springs which form a pool and a small brook, the Red Burn, about a mile in length, which joins the Ver a short distance below the village. This brook does not always flow; in fact, its flowing was held in superstitious times to presage some calamity. Now we take it as an indication that the water-level in the Chalk is comparatively high, and that our underground reservoir is not likely to be depleted in the ensuing summer.

The Church, dedicated to St. Mary, was first visited. It is believed to mark the site of an ancient village, the present Norman building, erected about 1100, standing on a Saxon site. All which remains of Norman construction, however, is the arcade of the north aisle and possibly the small pointed western

arch. The west tower retains much of its twelfth century design. "The most noticeable feature of the Church," Cussans says in his 'History of Hertfordshire' (Cashio Hundred, p. 233), "is the chancel screen supporting the rood-beam. It is of carved oak and is the only example of a groined and canopied screen in the County. Its western face is absolutely perfect, but on the other side the canopies have been replaced by deal, and painted." There are traces of several sun-dials on the Church, which are most clearly seen on a buttress on the south side of the nave and on that south-west of the chancel.

Leaving the Church the party inspected the ancient entrenched camp called the Aubreys, walking all round it in the hollow so far as it was passable, but it was partly under water. The camp has been described in the account of a previous meeting.

After having tea in Redbourn the party dispersed.

FIELD MEETING, 6TH JULY, 1907.

DUNSTABLE, MAIDEN BOWER, AND TOTTERNHOE.

This was a joint meeting with the Barnet Natural History Society, and was under the direction of Mr. James Saunders, to whom the Editor is indebted for the information in the following account.

The party, numbering over twenty, on leaving the train at Church Street, Dunstable, proceeded to the Priory Church, the principal architectural features of which were duly appreciated, especially the well-known Norman arch of the west front.

A field-path was then taken to Maiden Bower near Sewell. This consists of a circular mound enclosing a field of several acres in extent, now under cultivation. Depressions seen in the mound indicate the points of exit. Many flint flakes and implements, relics of the prehistoric occupiers, have been found here by Mr. Worthington G. Smith. In the field there were observed several plants of an agrarian weed known as the large earth-nut, *Carum Bulbocastanum*. It is of comparatively modern introduction as a Bedfordshire plant, probably early in the nineteenth century, and at present its known distribution in England is confined to Cambs, Herts, Beds, and Bucks.

The party then passed by the lime-works on the north-west of the Totternhoe Hills where a large exposure of the Lower Chalk is visible, as it is extensively used for the making of lime. Only a small section of Totternhoe Stone is now exposed, owing to the demand for it being very small.

On reaching Totternhoe Knoll the Roman earthworks were seen, and also the depressions in the ancient greensward which mark the positions of the original hut-circles. Amongst the plants noticed here were *Polygala vulgaris*, *Hippocrepis comosa*, *Pimpinella major*, *P. saxifraga*, *Galium tricorne*, *G. saxatile*, *Avena pubescens*, and *Kœleria cristata*.

The Director commented upon the effect on the native flora of the enclosing and draining of the land in the parish of Totternhoe, which was effected about twenty years ago. The draining of a field near Totternhoe Church resulted in the extinction of a rare moss, *Hypnum Sendtneri*, from its only known station in Beds. Associated with it were the flowering plants *Parnassia palustris* (grass of Parnassus), *Pinguicula vulgaris* (butterwort), and *Anagallis tenella* (bog-pimpernel), all of which are rare locally. The grass of Parnassus and the bog-pimpernel are now extinct in this station, but the butterwort still lingers on the sides of the ditches by which the drainage is effected.

In the evening, after having tea in the village, the members of the two societies walked back to Dunstable partly by the high road and partly by the ancient green ways, the botanists finding occupation in noting the features of the Chalk flora.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIET

AND

FIELD CLUB.

EDITED BY JOHN HOPKINSON, F.L.S., F.G.S., F.R. Met. Soc., Assoc. Inst. C.E., Sec. Ray Soc.

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HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

The objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, Ethnology, Pre-Norman Archæology, and Topography of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Physics and Biology. 4. The formation of a Library of works on Natural History. 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

Evening meetings of the Society are held in the rooms of the Watford Urban District Council (Upton House) once a month during the Winter and Spring, and also occasionally at St. Albans and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10*s*., and an Annual Subscription of 10*s*. for which they may, if preferred, compound for life by a payment of £5. Ladies are eligible for election.

Donations to the Library, and letters relating thereto, should be addressed to the Librarian, Daniel Hill, F.R.H.S., Herga, Watford. Subscriptions, etc., are payable to the Treasurer, John Weall, 38, High Street, Watford.

Members receive the publications of the Society, and may obtain further copies, postage free, at a reduction of one-sixth from the published price, by remitting to the Assistant, H. Foxen, 38, High Street, Watford.

Forms of proposal for Membership, and any further information, may be obtained by application to either of the Honorary Secretaries—

A. E. GIBBS, F.L.S., F.R.H.S., Kitchener's Meads, St. Albans.
ALFRED SUTTON, A.R.S.M., Wolstanbury, Watford.

TRANSACTIONS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

I.

THE RIVER-SYSTEM OF WESTERN HERTFORDSHIRE.

By ALFRED SUTTON, Assoc. R.S.M.

Read at Watford, 23rd October, 1905.

THE records of the Hertfordshire Natural History Society contain several references to certain of the rivers of the county, and a general description of them occurs in Mr. Hopkinson's Introduction to Pryor's 'Flora of Hertfordshire,' but the system presents features of interest in relation to modern theories of river-development which do not appear to have been specially treated. It is the object of this paper to point out the bearing of these theories in considering the development of this particular system, and to suggest certain possible solutions of the problems which present themselves, rather than to set forth the results of my own investigations into the subject.

The whole of western Hertfordshire, except two small portions, one at the extreme north-west beyond Tring, and the other at the south near Barnet, drains into the Colne, so that we are concerned only with the head-waters and tributaries of a single river, and indeed mainly with its upper, though principal, tributaries, the Chess, the Gade, the Bulbourne, and the Ver. These tributary streams all rise near the escarpment of the Chalk in the Chilterns and adjacent hills. Thence they flow in a general south-easterly direction until they are confronted by the barrier of the Tertiary beds which rises along the Middlesex border. They then unite in the Colne, which flows first south-west along the outcrop of the Chalk, and then south through the Chalk to join the Thames at Staines. The area they drain must formerly have been much more extensive than it is now, for the dip-slope down which they flow clearly extended much farther to the north-west, and indeed Professor Ramsay gave it as his opinion that the Chalk formation extended originally over the Oolites away to the mountains of Wales.

I do not put forward the theory that the rivers under consideration originally had their rise so far to the north-west; indeed, their valleys are not large enough, and they are too close together to warrant such a supposition, but there can be no doubt that, as was pointed out by Sir John Evans in an early number of the Society's 'Transactions,' they had their rise far to the north of their present sources. Lord Avebury refers to them in his recent book on 'The Scenery of England' as "beheaded rivers"; that is to say, rivers whose upper portions have disappeared owing to the action of rival river-systems, and of subaerial denudation generally, in wearing down the drainage-area which formerly fed them, and converting it into an area of contrary inclination feeding the rival streams.

The upper portions of the former area of drainage of our rivers has thus been captured by the Upper Thames and the Ouse, owing to the more rapid action of these larger streams in eroding their valleys in the softer material of the Lower Cretaceous beds, and the atmospheric influences which have worn back the escarpment of the Chalk. We see, therefore, at the heads of the valleys of all our rivers, gaps in the Chalk escarpment through which the rivers formerly ran. These gaps are, however, at such an elevation as to preclude the idea that the rivers ever rose beyond the original escarpment, like some of those in the Wealden area, which rise beyond the Chalk and cut their way through it. Their sources, it would seem, must always have been south of the escarpment, and must have receded with it. Mr. Hopkinson has pointed out, in the Introduction to Pryor's 'Flora,' already referred to, that they are all formed by overflow from the level of saturation of the Chalk, which forms an immense spongy reservoir, never entirely emptied, and I think that they were always fed almost exclusively in this way.

In considering the development of any river-system, we must, as Lord Avebury says in his book already mentioned, carry our minds back to a time when the streams composing it flowed at a considerably higher level than at present. When our rivers first commenced to flow, the whole of the area over which they ran was probably covered by the Tertiary beds, outliers of which still occur far from the main formation, and the surface was no doubt several hundred feet higher than at present. The superincumbent material which once formed the soil of Hertfordshire has been carried away and deposited in the German Ocean, except the stony fragments which now constitute the beds of gravel and "clay with flints" overlying the Chalk nearly everywhere, the larger blocks of Hertfordshire conglomerate (pudding-stone), and the Sarsen stones or "grey wethers," which are scattered over the country. At this early period the general level of the country was probably higher than the summits of the ridge which now runs along the Middlesex border, rising at Bushey Heath and Stanmore Common to an altitude of over 500 feet above sea-level, and our rivers possibly

continued their course over this ridge and found their way independently to the Thames. It is this possibility that I wish to enlarge upon, and to suggest in connection with it the probable early course of some of our rivers.

The modern theory of the development of such a river-system, as expounded by Professor Davis, Professor Russell, and others, is admirably summarized in Lord Avebury's book. It may be briefly stated as follows:—As soon as a sloping plane of drainage is established by elevation or depression taking place over a large area, a series of streams will commence to flow, taking the path of least resistance down the slope in roughly parallel lines. Where, as in the present instance, the slope lies across the outcrops of a series of beds of different hardness, the softer beds will be worn away more quickly than the harder, and the valleys will be widened most in the softer parts, giving rise to lateral streams, especially behind a band of harder material. That stream which has the widest area of drainage will be the largest, and will wear down its valley more quickly than the others, and its tributaries will wear back their head valleys, and gradually encroach on the drainage-area of adjacent smaller streams until they actually cut into the main valleys of those streams and draw them off or "capture" them, as it is termed. The valley of a captured river below the point of encroachment then becomes the bed of a much smaller stream, the head of which retreats down the valley as the encroaching stream still further enlarges its drainage-area. The upper part of the beheaded valley may then become the bed of a small stream, flowing in the contrary direction, and therefore called an "obsequent" stream, which falls into the encroaching river. The lower part of the valley will thus become a wide gap, from the highest point of which small streams will flow in both directions.

There are two such gaps in the ridge of the Tertiary beds near Watford, at Oxhey and Northwood respectively, which are in the direct lines of the valleys of the Gade and the Chess, and only about sixty feet above the present levels of these rivers where they fall into the Colne. My suggestion is that the Gade and the Chess formerly flowed through these gaps in direct continuation of their present courses. The ridge east of Stanmore Common may also have been traversed by the Ver at a time when that river flowed (as it or its predecessors must have done at some remote period) at a height of nearly 400 feet above sea-level; but in this case there is no well-defined gap at present existing, though there are several minor gaps. The cap of higher Tertiary gravels which surmounts the ridge referred to would provide a hard band behind which such a development of lateral streams would be likely to take place, especially having regard to the fact that the Lower Tertiary sands immediately overlying the Chalk would offer an area in which such a series of lateral streams could form and wear down their beds.

I suggest, therefore, that the Ver was first diverted from its direct course at a very remote period, and captured by a tributary of the Gade, occupying the present valley of the Colne above Watford. The Gade itself then probably flowed through the Oxhey gap, where the North-Western Railway now runs, and was subsequently captured by the Chess, which ran through the Northwood gap along the present course of the Metropolitan Railway. Finally, the Chess, in its turn, was, I imagine, captured by the Misbourne, a tributary of which worked its way back along the present valley of the Colne below Rickmansworth, since which time the system has maintained its present course, and the rivers have reached a condition of equilibrium, though their tributary streams on both sides continue to wear back their head valleys. I would point out that some of the head-waters of the Colne now approach very close to the main stream of the Lea above Hatfield, and are at an elevation but little above the level of that river, so that it is quite within the bounds of possibility that the Colne may capture the upper portion of the Lea also,* if allowed to work out its destiny, though doubtless such a consummation would be prevented by artificial means if it ever threatened seriously to accomplish itself.

I put forward these suggestions with diffidence, and rather as a suitable subject of investigation than as a verified hypothesis. If the Gade and the Chess ever flowed through the gaps referred to, they would have deposited beds of gravel which should furnish indications of their origin, and I venture to hope that the attention of those of our members who are better qualified than I am to judge of the nature of such deposits, will be directed to the subject, so that the truth or otherwise of the theory I have broached may be established.

* As the rain which falls on the London Clay area in the higher part of the valley of the Colne, flows, through swallow-holes, into the Chalk, which dips south-east towards the valley of the Lea, it almost certainly augments the volume of that river, which is thus, through underground channels, capturing the head of the Colne.—Ed.

II.

NOTES ON LEPIDOPTERA OBSERVED IN HERTFORDSHIRE IN THE YEAR 1905.

By A. E. Gibbs, F.L.S., F.R.H.S.

Read at St. Albans, 6th March, 1906.

There is only one species to be added to our county list as the result of the work of local lepidopterists in 1905, as against seven in 1904, this being the smallest number of additions for many years. The species is *Senta maritima*, Tauch. (*ulvæ*, Hb.), taken at Tring by Mr. A. T. Goodson.

This is a very interesting record, for *Senta maritima* is usually supposed to be found only in the eastern counties, and principally in the fen districts. It haunts reed-beds, and is seldom seen in the daytime, flying after dark.

The distribution of the Rhopalocera or butterflies in the county has received so much attention that there is really very little fresh to be said about it. Miss Alice Dickinson, of New Farm, St. Albans, reports the presence of a specimen of the second brood of the clouded yellow (*Colias edusa*) on the railway-bank near Harpenden on August 2nd. This is one of the most variable of our British butterflies in point of abundance, but judging from the few observations printed in the entomological magazines I do not think that 1905 has been an average year. Miss Dickinson also tells me that she did not see any specimens of either the spring or autumn brood of the holly-blue butterfly during the past year. This is an insect which sometimes frequents my garden, but, as was the case in 1904, I failed to detect its presence. *Lycæna argiolus* is a delightful little butterfly. It is double-brooded, the first generation appearing in April or May, as soon as the weather begins to get warm, and the females lay their eggs on the holly, the larvæ feeding on the buds, blossoms, tender berries, and young leaves. The second or autumn brood which results from these holly-feeding larvæ, are on the wing in July and August, and these lay their eggs on the ivy, which being an autumn-flowering plant, furnishes abundance of blossoms to provide the caterpillars with food. When beating the ivy-bloom for moths at night I have occasionally taken these curious larvæ, which are not unlike wood-lice in shape. Miss Dickinson reports the capture of the variety *cæruleopuncta* of the small copper butterfly (*Polyommatus phlæas*), which, so far as my observation goes, is not so abundant as was formerly the case. This aberration is distinguished by the presence of blue spots on the hind wings. Other butterflies mentioned by Miss Dickinson are the painted lady (*Vanessa cardui*) seen in small numbers in September, and the brimstone butterfly (*Gonepteryx rhamni*) on the wing on October 29th. This latter species hybernates on the approach of the cold weather, and is often one of the first insects to gladden

our eyes with its brightness in early spring. The late Mr. C. E. Barrett pointed out that it is one of the longest-lived butterflies known, for it generally issues from the chrysalis in July or August, and worn hybernated specimens have been seen flying so late as July 7th in the following year. In very forward seasons freshly-emerged specimens have been on the wing so early as June 30th. It is probable, therefore, that individual specimens may sometimes attain the advanced age of twelve months. Most of the butterflies that frequent the Chalk downs were to be found in their usual haunts last year, though I have received no notes of the occurrence of the Clifton blue (*Lycæna adonis*). Mr. P. J. Barraud, of Bushey Heath, writes: "I only paid one visit to Aldbury Downs during the season (August 5th). *Lycæna corydon* and *Hesperia comma* were plentiful as usual, as was also *Epinephele janira*. I also saw or took *Gonepteryx rhamni*, *Vanessa cardui*, *V. urticæ*, *Epinephele tithonus*, *Polyommatus phlæas*, *Lycæna astrarche*, and *L. alexis*."

Only two correspondents report the presence of the death's-head hawk-moth, our largest British lepidopteron, which owes its popular name to the fact that the markings on its thorax resemble a skull and cross-bones. Although it is regarded with dread by many people, I need scarcely say that it is perfectly harmless. It possesses the power of uttering a curious squeaking sound, and is said to enter beehives in the search of honey. The larvæ feed on potato-tops, and pupate in the earth, both caterpillar and chrysalis being occasionally found in potato-fields. This hawk-moth has a wide range, being distributed over the whole of Europe and parts of Africa and Asia. It is irregular in its appearance, being far more abundant in some years than others. Miss Dickinson received a pupa found at Leasey Bridge on October 18th, and she heard of the discovery of another, unfortunately injured, at Sandridgebury Farm. Mr. A. H. Foster, of Hitchin, had a fine specimen of this moth brought to him on June 30th, it having been picked up on the middle of the North Road near Baldock. He, however, did not hear of a single specimen of the larvæ being found this season.

Miss Dickinson informs me that she found a goat-moth (*Cossus ligniperda*) on a hawthorn-tree at sugar, this being the second time she has taken the insect at or near sugar. I am inclined to think that this moth is attracted by sweets, for I have seen it myself on the sugar patches. Other insects reported by the same observer are *Notodonta camelina*, beaten from hazel in Sparrowswick Wood; *Bryophila perla*, on sugar in garden in July; *Acronycta tridens*, a larva of which was found by Mr. Arthur Dickinson at Symond's Hyde in August, 1904, the perfect insect emerging in June, 1905; *Neuria reticulata* (*saponariæ*), three specimens taken at sugar; *Dianthecia cucubali*, several at sugar; *Cucullia umbratica*, six taken hovering over delphinium in garden; *Plusia moneta*, *P. chrysitis*, and *P. pulchrina*, fairly plentiful hovering over flowers; *Venilia*

macularia, very plentiful in a lane near Oaklands; *Eugonia erosaria*, bred from lava found in Leasey Bridge garden; *Amphidasys strataria*, on pavement in St. Michael's, April 9th, smashed; also *Hemerophila abruptaria*, *Acidalia aversata*, *Timandra amataria*, *Anticlea nigrofasciaria* (*derivata*), on beech, *Triphosa dubitata*, and *Pelurga comitata*.

Mr. C. G. L. Ellis, of Girvan, Battlefield Road, St. Albans, took *Neuria reticulata* (*saponariæ*) in his garden in July.

In addition to increasing the county list by the capture of a species new to Hertfordshire, Mr. A. T. Goodson has taken *Scoparia pallida*, an insect which previously had only been recorded for Sandridge. Mr. Goodson's locality for this moth is Dundale, near Tring.

Mr. A. H. Foster, of 13 Tilehouse Street, Hitchin, again supplies me with some valuable notes. He reports the capture of three specimens of *Geometra papilionaria* at light, two being found on street lamps and the third in Mr. Grellet's house. This is the first season he has observed this insect at Hitchin, and it is noticeable because of the scarcity of its usual food-plant, birch, in the neighbourhood, though I believe the larva has been found on hazel and beech. One of the pug-moths, *Eupithecia scabiosata* (*subumbrata*), of which the only other county record is from Tring, was excessively abundant on Pegsdon Hills, where Mr. Foster took quite a hundred specimens in two or three outings, and could have taken many more. The same observer records the capture for the first time at Hitchin of *Melanthia albicillata* in Mr. Grellet's garden. *Anticlea cucullata* (*sinuata*), which was introduced into the county list last year, again occurred, both Mr. Foster and Mr. Grellet capturing single insects. Our informant says he was hoping to take this species in some numbers by beating the hedges on Pegsdon Hills, but could only find the one specimen. In July Mr. Foster captured five examples of *Coremia quadrifasciata* on palings, but four of them were too bad to be worth keeping. Mr. Grellet also took one worn specimen. Our correspondent says that he has never seen this insect at Hitchin before, and it seems to him remarkable to be able to suddenly account for six specimens in one season. It is, however, in Mr. Durrant's list for the Hitchin district, and appears to be pretty-well distributed throughout the county, being recorded for Hitchin, Haileybury, Hertford, Sandridge, St. Albans, Watford, and Tring. *Cymatophora octogesima*, which was added to our list in 1901, and has since been recorded from several stations, appears to be getting more abundant. Mr. Grellet took six in his garden at sugar between June 20th and July 28th. Remarking upon this fact Mr. Foster expresses the opinion that this is the most important capture of the season. *Notodonta dictæa* was rather abundant on the street lamps at Hitchin, and *Apamea unanimis* was secured at light by Mr. Grellet. This last-named insect also occurred at St. Albans, one specimen emerging in my breeding-

cage. The larvæ were abundant in the previous autumn on the striped ribbon-grass and *Phalaris arundinacea* growing at the edge of my fish-pond, but I was unsuccessful in getting them through the winter, the caterpillar from which my specimen was reared being captured after hybernation in the early spring. Of *Agrotis ravida* Mr. Grellet took nine specimens at sugar in his garden, while *Cirrhœdia xerampelina* was comparatively common on street lamps late at night. Other insects new to the district reported by Mr. Foster are *Hesperia comma, Asteroscopus sphinx, Zonosoma annulata, Asthena candidata, Bapta temerata, Emmelesia albulata* and var. *thules, Eupithecia venosata,* and *Melanippe unangulata.*

Mr. Philip J. Barraud reports from Bushey Heath as follows:—"The season on the whole has been a good one for Lepidoptera. About the usual number came to light at my window, five species being new to my list, viz. *Dianthecia cucubali, Eupithecia pumilata, Scoparia ambigualis, Yponomeuta padellus,* and *Harpipteryx xylostella,* making three hundred and six species taken at light at this one locality. Other species taken in the same way were *Drepana binaria, Pterostoma palpina, Luperina cespitis, Caradrina morpheus, Noctua triangulum, Triphæna janthina, Calymnia pyralina, Selinia lunaria, Eugonia alniaria, Geometra papilionaria, Eupithecia exiguata, Melanthia ocellata, Zanclognatha grisealis, Pyrausta purpuralis, Xanthoseta zoegana,* and *Scoparia mercurella.* Sugaring, which had been of very little use during the previous few years, was attractive in August and September. Occasional visits were made to Bricket Wood, and the following were taken or seen:—*Cymatophora or, Asphalia diluta, Agrotis suffusa, Noctua baja, Triphæna janthina, T. orbona, Amphipyra pyramidea, Mania maura, Xanthia fulvago, Calymnia trapezina, Dianthecia cucubali, Gonoptera libatrix,* and other commoner species. I also sugared in the garden during the same months and took most of the above, and in addition, *Caradrina cubicularis, Noctua plecta, N. c-nigrum, N. festiva, N. rubi, Amphipyra tragoponis, Anchocelis lunosa, Xanthia ferruginea, Meselia oxyacanthæ, Hadena protea, Catocala nupta, Eupithecia absynthiata, Coremia designata, Cidaria truncata, Hypæna rostralis,* and *Teras contaminana.* On June 16th I went dusking at Bricket Wood, and netted among other insects *Caradrina cubicularis, Timandra amataria, Acidalia candidata,* a very dark *Cidaria truncata,* and *Zanclognatha grisealis.* On the 27th of the same month I went again and got a lot of common insects, including *Hepialus humuli,* and a female *Angeronia prunaria.* The latter laid about 400 eggs, the larvæ from which I sleeved on plum and they are now hybernating. Dusking in June in the garden produced *Xylophasia rurea, Apamea basilinea, Eupithecia absinthiata, Eurrhypara urticata,* and *Pardia tripunctana.* A single specimen of *Hepialus hectus* was found on a window in the house on August 23rd, and one of *Platipilia gonodactyla* in the same situation on June 17th."

By the removal of Mr. Arthur Cottam from Watford we lose one of our most careful observers. Before leaving the county he sent to me a short note recording the capture on June 3rd at Aldbury of a specimen of the small elephant hawk-moth (*Chærocampa porcellus*), and on the 13th his friend Mr. Ernest Perrott took another in the same locality. Two more specimens of this pretty insect were taken by Mr. Cottam flying over honeysuckle in his garden at Eldercroft, Watford, *C. elpenor* and *Plusia moneta* being captured in the same way.

Mr. V. P. Kitchin, of The Priory, Watford, has sent to me the following short list of insects he has captured. Although some of them are uncommon, not one is new to the Watford district:—*Thecla w-album, Sesia tipuliformis, Drepana binaria, D. cultraria, Nudaria senex, Axylia putris, Epunda viminalis, Noctua triangulum, Cosmia pyralina, Pericallia syringaria, Numeria pulveraria* (Bricket Wood), *Bapta bimaculata* (Bricket Wood), *Macraria liturata, Erastia fasciata, Melanthia bicolorata, Lobophora viretata, Phibalapteryx lignata, P. viretata, Larentia viridaria* (Chipperfield), *Cidaria populata*, and *Schœnobius mucronellus*.

Mr. G. B. Digby writes to me from 9*a* The Parade, Winton, Bournemouth, informing me that he took *Phigalia pedaria* and *Drepana lacertinaria* at Bushey Heath. In the previous summer he captured a larva of *Acronycta alni* in a garden at Watford. It, however, turned out to be infested by a dipterous parasite.

Mr. W. C. Boyd, of The Grange, Waltham Cross, announces the capture of one of the plume-moths (*Œdematophorus lithodactylus*), which has only been recorded previously from Sandridge, and the recurrence at light of *Myelophila cribrella*, which now seems to be a regular visitor.

I fear that my own local observations during 1905 are hardly worth putting on record. Sallow in March yielded the usual insects. The larvæ of *Plusia moneta* were again fairly plentiful, and occurred both on aconite and delphinium. I noticed this insect, of which I exhibited a rather long series last year, in the larva, pupa, and imago stages. Sugar, both in my own garden and at Bricket Wood, yielded the usual species, nothing very remarkable having been obtained. A few insects, mostly common ones, came to light. Very few moths visited ivy-blossom in the autumn, a cold October doubtless being the cause. The insects taken at the field meeting held at St. Albans do not call for any special remarks; a few of the commoner butterflies were on the wing, and *Bapta bimaculata* was beaten out of the hedge at Beech Bottom.

III.

COLEOPTERA NEW TO THE HERTFORDSHIRE FAUNA.

By E. G. Elliman and C. T. Gimingham.

Read at St. Albans, 6th March, 1906.

The following are four additions to the list of Hertfordshire Coleoptera :—

Stenus opticus, Grav.—Taken in dead rushes, Little Tring, near Tring.

Podabrus alpinus, Payk.—Taken at St. Albans by Mr. A. E. Gibbs.

Longitarsus curtus, All.—Taken at Tring in 1904. This species has lately been recorded as British by Mr. J. R. le B. Tomlin, on the authority of specimens found in the Isle of Man. It now appears that these Manx specimens are a small form of *L. melanocephalus*, Deg. I have submitted the specimens taken by myself to M. Bedel, and he is quite positive as to their identity. The species has been found on *Echium vulgare* in France : in the case of my own specimens I believe them to have been living upon a species of *Myosotis*. *L. curtus* bears a considerable resemblance to *L. lycopi*, Foudr.

Apion Schönherri, Boh.—Found in haystack refuse at Tring.

E. G. Elliman.

The following three species of Coleoptera lately captured in Hertfordshire are additions to the county list :—

Gnathoncus rotundatus, Kugel.

Dendrophilus punctatus, Ill.—Both these species were taken from the débris of an old owl's nest in a decayed tree-stump in Lamer Park, Wheathampstead, in May, 1905.

Scolytus multistriatus, Marsh.—This I found in my garden at Harpenden in July, 1904. I had quite a large colony that summer in some rustic woodwork, but I have not seen one there since.

C. T. Gimingham.

IV.

NOTES ON LAND AND FRESH-WATER MOLLUSCA OBSERVED IN THE NEIGHBOURHOOD OF ST. ALBANS.

By G. E. Bullen.

Read at St. Albans, 6th March, 1906.

(Communicated by A. E. Gibbs, F.L.S.)

During the summer and autumn of last year I devoted some little time to the casual study of the Mollusca of this county, and although I entered but lightly upon the matter I was convinced that there lay before me in coming summers a most fascinating field of natural-history study. I feel, however, that in presenting this necessarily brief paper to your notice I am trespassing to a certain extent upon Mr. Hopkinson's province, he having devoted, as many of you are aware, much time to the careful study of the land and fresh-water molluscs of the county, and from the localities indicated in his papers many of my specimens were obtained.

I first spent some weeks in investigating the fauna of the Ver near St. Albans, together with its backwaters, and found specimens in quantity, but there were only a few species. The following is a list of them:—*Sphærium corneum*, *S. lacustre*, *Pisidium amnicum*, *P. pusillum*, *Anodonta cygnea* (the swan-mussel), *Paludina vivipara*, *Bythinia tentaculata*, *B. Leachii*, *Valvata piscinalis*, *Physa fontinalis*, *Planorbis vortex*, *P. carinatus*, *P. complanatus*, *P. corneus*, *Limnæa peregra*, *L. auricularia*, *L. stagnalis*, *L. palustris*, and the little fresh-water limpet, *Ancylus fluviatilis*; 19 species in all.

I do not presume that this list is in any way a complete one, but it was compiled after an intermittent period of work extending from May to October.

The second species of fresh-water limpet, *Velletia lacustris*, I consider by no means common in the county, it only falling to my lot once to obtain it, this being in a pond opposite to Mr. Ellingham's house on the road from Cupid's Green to Leverstock Green, although the larger species, *Ancylus fluviatilis*, may be found attached to stones in the canal at Boxmoor, in the Ver, and in the Lea at Harpenden, and at Wheathampstead in comparative abundance. I have also taken *Physa hynorum* in the canal at Boxmoor.

The amber snail, *Succinea putris*, is fairly common on the rushes bordering the Lea near Harpenden, but I have never taken the allied species, *S. elegans*, there, although at Boxmoor in August it was extremely common amongst the reeds, together with a true snail, *Helix sericea*. It was interesting, moreover, to notice that this species appeared to live in companies; hundreds were distributed over a comparatively close area, whereas a little distance away scarcely a single specimen was

to be seen. The green variety of this pretty mollusc, var. *virescens*, was also there, but in scarcity. The exquisite little glass snail, *Vitrina pellucida*, appears to frequent situations close to water, and is irregularly distributed. I have found it in fair numbers, however, in my garden at St. Michael's amongst damp moss and decaying leaves.

In the same locality I collected seven species of *Zonites*, generally under stones: *Zonites cellarius*, *alliarus*, *glaber*, *nitidulus*, *purus*, *nitidus*, and *crystallinus*. I used to overturn certain large stones once every fortnight, and invariably was rewarded by finding four or five species of this genus beneath. The species of this genus, I would remind you, are most difficult to determine unless the identification is carried out whilst the animal is still living.

Hertfordshire may boast of harbouring in its hedgerows a marketable delicacy in the person of the edible snail, *Helix pomatia*, the so-called "Roman snail," but whether it be a relict of the Roman occupation or not I am not in a position to say.* However, this handsome mollusc occurs locally in quantity; at one spot near Hatfield, I am informed, it is plentiful, and it has also been recorded at Puckeridge, St. Albans, Hemel Hempstead, and elsewhere. I have obtained it at Hemel Hempstead, but only very occasionally. Those of you who have never essayed the gastronomic possibilities of this mollusc should, I consider, from a purely personal standpoint do so; it is excellent when well cooked, and moreover, I am informed, is a suggested palliative for consumption, but whether this referred to the ailment or the consumption of snails as an article of diet I was unable further to ascertain.

Of the genus *Helix* I have taken in this county twenty species, specimens of which I have pleasure in exhibiting. At least half of this number can be obtained by careful search in any garden, and a bed of nettles will prove a most productive hunting-ground. *Helix aculeata* I have taken at Redbourn and at Watford; *Helix pulchella* I have obtained once in my garden at St. Michael's and often at Cassiobury and Ashridge, where also (at these two last-named localities) I collected the so-called rock-cutting snail, *H. lapicida*.

My specimens of *Bulimus obscurus* and *Pupa umbilicata* and *marginata* all came from amongst damp moss in Highfield Park, Hemel Hempstead. But after much careful searching I only once fell in with a species of the genus *Vertigo*, and that the commonest, *V. edentula*, in the same locality, although I have obtained four different species in Cornish woods.

Balea perversa I have collected near Bedmond, Leverstock Green, Sandridge, and other localities, but I do not consider this species to be other than very local in its distribution.

* In some localities it may have been thus introduced, but it was present in Britain long before the Roman occupation.—Ed.

Clausilia rugosa is perhaps the commonest of those elegantly-shelled molluscs, whose generic name is derived from the presence of an exquisitely contrived shutter, similar in office to an operculum, which automatically closes on the retirement of the animal within the shell, thus affording complete protection from the cold during winter months.

The larger species, *Clausilia laminata*, I collected on one occasion from a fallen tree-trunk situated close to the road between Hemel Hempstead and Redbourn; there were at least thirty specimens herded together within as many square inches in this particular situation. On the first occasion that I noticed them I was unprovided with boxes, and so determined to leave my selection of half a dozen of their number until the following day. In this I was prevented, but returned after a week had elapsed to find the birds flown, at least from the particular spot whereon I had noticed them. A careful search revealed them not, and I was turning to go, thinking perhaps that some hungry thrush had forestalled me, when I happened to pull away a piece of loose bark, and there, packed closely together, were my Clausilias, They had doubtless retired thither to gain shelter from the sun.

This close herding is noticeable, moreover, in the pretty little *Cochlicopa lubrica*, which also seems to prefer company. On one occasion I counted 47 specimens of this tiny species under moss in my garden at St. Michael's, in a space not more than a foot square.

The last example which I will mention in this brief paper is *Cyclostoma elegans*, a species which also well deserves its specific name. I would remind you that this is a typical example of an operculate land mollusc, the operculum being, as you will observe in the specimens exhibited, a highly-developed structure identical with the complementary valve in a bivalve mollusc. This species may be met with wherever the chalk appears on the surface throughout Hertfordshire. But although dead shells may be observed in quantity in such localities, the living animal often escapes notice on account of its habit of burrowing a little distance below the surface of the ground.

V.

ALBINO MOLES IN HERTFORDSHIRE.

By A. E. Gibbs, F.L.S., F.R.H.S.

Read at Watford, 2nd April, 1906.

On the 23rd of March, 1906, Mr. T. Fowell Buxton, of Easneye, informed me that white moles had been taken on the Waters Place Farm, near Ware. They were white all over, slightly tinged with yellow. A similar albino mole was killed on the same farm many years ago.

Shortly afterwards Mr. J. P. Sambels, of Cole Green, sent two specimens to the Hertfordshire County Museum for preservation, one of which I am able to exhibit to-night.

On applying to Mr. Sambels for further particulars, he kindly sent to me the following interesting notes on the subject:—

"The neighbourhood of Cole Green and Panshanger has long been noted for 'white' moles, specimens having been trapped from time to time, often at intervals of years. One preserved specimen in the possession of a cottager was taken some fifty or sixty years ago. About 8 or 9 years ago another cottager caught a very fine specimen, but although I have year by year since then offered a reward for a specimen, none has, I believe, been caught in the neighbourhood until last spring.

"This year they appear to have been abnormally plentiful. The first to be captured was at Bayfordbury, on the ridge south of the Lea, but when taken to Mr. H. Clinton Baker it was too stale for preservation. The next to be captured was in Woolmers Park, about a quarter of a mile from Cole Green Station. This was sent to Mr. R. T. Andrews for his museum at Hertford. About a fortnight later two were trapped very near the same spot and brought to me. One of these is now in the Hertfordshire County Museum and the other is at the Watford Public Library. Three days later another was caught and given to a naturalist by Mr. Wodehouse. Thus four specimens were trapped very near each other at Woolmers within about a month. About the same time two specimens were taken at Easneye, which is about five miles distant from Bayfordbury and about seven miles from Panshanger, Cole Green, and Woolmers."

VI.

ADDRESS.

INORGANIC EVOLUTION.

By the President, JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S.

Delivered at the Anniversary Meeting at Watford, 26th March, 1906.

LADIES AND GENTLEMEN,—

The subject to which I wish to direct your attention this evening is, I think, of absolutely surpassing interest. I cannot pretend in any way to do justice to it. The question of Inorganic Evolution is not only exceedingly difficult, but the subject is so vast that I cannot do more than, as it were, merely skim round the outer edge of it and pick out here and there matters which I think are of importance and may be of interest. I trust, then, that you will bear with me and not be too critical; and also that you will pardon all imperfections and omissions.

Some faint and glimmering idea of the doctrine of Evolution, which is that all the existing species of plants and animals which we find on the earth were originally derived from one or from a few primæval forms, seems to have dawned upon the minds of some of the ancient Greek and Roman philosophers; and some such shadowy notion may have floated through the brains of the sages of the Nile or the wise men of Shumer and Accad; but it was not till the eighteenth century of our era that naturalists began seriously to question the traditional belief that each individual species came into existence some 6,000 years ago by a separate creative fiat, and had remained essentially the same ever since. Several thinking naturalists at that time, amongst them Lamarck and Erasmus Darwin, promulgated theories of some kind of evolution, which were received for the most part with ridicule and scorn. Lord Monboddo, a learned and very eccentric Scotch judge, was held up to derision for asserting that men might possibly be descended from monkeys. He is alluded to in the notes to Boswell's 'Life of Johnson' as having "exposed himself to much deserved ridicule by his whimsical speculations relative to a supposed affinity between the human race and the monkey tribe." It was not until the year 1858 that the great Darwin, the grandson of Erasmus Darwin, after 20 years of laborious research and patient study, and the famous naturalist Alfred Russell Wallace, an illustrious veteran who is still amongst us, full of years and honours, enunciated

simultaneously the doctrine of Evolution by means of Natural Selection, which is now held in some form or other practically by all scientific men of the present day.

The principle underlying the theory of Natural Selection is this. The descendants of all living organisms tend to vary from their progenitors in some limited degree. Each creature differs from its parents to some slight extent. Sometimes these variations are to the benefit of the offspring, and sometimes they are not advantageous. Those organisms in which the variations are beneficial have an advantage over the others in the struggle for existence, and this tends to their survival and reproduction. Repeated variations of this kind in process of time modify the organism materially, and after many generations what we call a new species is the final result. The teaching of Darwin is that though natural selection is the principal agent in evolution, other influences, such as use and disuse of parts, sexual selection, etc., play an important part in the modification of pre-existing types. But evolution, in the widest sense of the word, teaches, not only that all living organisms, however complex in type and different in character, are derived from the lowest and most simple forms of life, but also the derivation of all the various bodies throughout the universe, the earth and the planets, the sun and all the innumerable host of stars which gem the firmament of heaven, from simpler and perhaps less complex forms of matter. Nay, more, it teaches us that the materials of which those bodies are composed, the very elements themselves, are the products of a process of evolution.

I will not go into the question of what matter is; whether it is really and veritably a separate entity; whether, as some have supposed, it is identical with electricity or energy (certain it is that matter as we know it appears to be inseparably connected with energy); or whether the ultimate atoms or corpuscles of which it is composed are merely vortices or whirls in the luminiferous ether, a perfect fluid which pervades the whole universe. Herbert Spencer thus defines Evolution: "Throughout the universe in general and in detail there is an unceasing redistribution of matter and motion. This redistribution constitutes evolution when there is a predominant integration of matter and dissipation of motion, and constitutes dissolution [or devolution] when there is a predominant absorption (or assumption) of motion and disintegration of matter." This statement is thus amplified and explained by Proctor: "This constant change in the distribution of matter and motion results in some cases in

the aggregation into one whole of portions of matter which before had been apart from each other, the motions of these several portions *inter se* coming to an end or greatly diminishing as they thus gather into a single mass. In such cases we have the formation of new masses. In other cases portions of matter which had aggregated into a single mass are separated from each other and begin to move freely *inter se*. In such cases we have the dissolution of the masses thus separated into their component parts." To take one instance, we may suppose, for example, that the Solar System at some inconceivably remote period consisted of an innumerable number of widely-separated particles of matter probably all homogeneous or similar in character, and endowed with a great amount of motion amongst themselves, and that in the course of myriads of ages these particles have become aggregated into various large and heterogeneous or dissimilar masses, namely, the Sun, Planets, Satellites, and other members of the System; while the motion of the particles amongst themselves has greatly diminished. To complete the illustration we must suppose that a time will come when the different particles of matter which now compose the earth, sun, planets, etc., will once more be widely separated, and again move rapidly and freely amongst themselves. This, indeed, is the essence of the most recent speculations as to the origin and perhaps the end of the Universe.

Let us never forget, however, that evolution, even in its widest sense, is not an attempt to disprove the existence of the Deity, but rather, so far as our limited faculties will permit, reverently to try and trace, and dimly to apprehend in some faint measure, some little inkling of the manner in which the Almighty Creator, by whom and in whom and for whom are all things, is working and has worked through all the ages past.

I can only sketch out very roughly and very briefly the lines on which we may imagine that the evolution of the Universe has proceeded.

During the last few years especially it has been suggested that evolution is not restricted to living organisms, but that our Earth and all the varied worlds and suns, and all the countless bodies that are scattered through boundless space, and even the very elements themselves as we know them, have undergone a process of evolution from simpler and comparatively homogeneous bodies to more complex and heterogeneous forms. It is this kind of evolution that I wish to say a few words upon to-night.

Let us begin with the Elements. In ancient times, and indeed up to comparatively recent days, it was usually asserted that there were four elements or primordial substances of which all things were composed, namely, Earth, Air, Water, and Fire. We now know that these are not in any sense of the word elementary. The first three may be looked upon as types of the three different states or conditions of matter with which we are familiar, while the fourth, Fire or Heat, is a form of energy. Modern chemists acknowledge about 80 different elements, many of them only discovered recently, and some of them of exceedingly rare occurrence. The accepted definition of an element is: "A substance which cannot be decomposed into simpler forms of matter by any process at present known to us." These elements combine with each other in various ways, and form compound bodies, the properties of the compounds being often quite dissimilar to those of their constituents. The elements combine with each other in certain definite and unvarying proportions. From these proportions, that is, the relative quantities or masses with which they enter into combination, what are called the atomic weights or combining powers of the elements have been deduced. The Atomic Theory is that the elements are built up of exceedingly minute bodies called atoms, these atoms differing in weight and probably in size for each element according to its combining power; that in elementary bodies two or more atoms combine with each other to form a molecule of the element which is the smallest quantity of the substance which can exist in a free state; and that two or more atoms of different elements combine with each other to form a molecule of a compound body. Thus two atoms of hydrogen combine with one atom of oxygen to form a molecule of water. The atoms vary in weight from hydrogen, which is represented by 1, to radium, whose atom is counted as 224, and uranium, the atomic weight of which is 238.

So far the Atomic Theory may be considered as absolutely proved. The word atom means indivisible, and it was believed till very lately that atoms were really minute indestructible particles of matter which could not be divided or altered in any way. Recent experiments, however, with the new metal radium and other elements of the same class have completely revolutionized our ideas. These researches have clearly shown that the atoms are not simple and indivisible, but are in reality compound bodies made up of thousands of almost infinitely minute particles which have been called corpuscles or electrons,

and that they differ in properties and in size simply as they contain a greater or smaller number of these corpuscles; all the corpuscles being exactly similar to each other in every respect from whatever source they may be derived. So that we have in reality only one and the same kind of primordial matter underlying and making up all the different substances which are in existence. An atom may therefore be looked upon as a body more or less spherical in form, of exceeding minuteness, constantly oscillating to and fro at a very rapid rate, and containing within it a very large number of inconceivably small bodies called corpuscles. The hydrogen atom, the lightest known, contains at least 1,000 corpuscles, while an atom of radium is composed of at least 224,000. The corpuscles are continually moving backwards and forwards within the atom with inconceivable rapidity, their rate of motion being at least 10,000 miles per second. These corpuscles are probably indivisible specks of matter. They are now known to exist under certain conditions in a free state. The flame of a candle, for instance, has been found to give off certain minute bodies called ions. These ions are of two kinds, charged respectively with positive and with negative electricity. The former, which are given off in greater quantity at a lower temperature and under greater pressure, are considered to be free atoms, that is, atoms not combined with other atoms to form molecules, as is the case in ordinary forms of matter whether compound or elementary. The latter, charged with negative electricity, and given off in greater quantity at a higher temperature and under lower pressure, are the corpuscles we are talking of. These corpuscles are also given off from highly heated metals and from glowing carbon. They travel with a velocity of from 10,000 to 90,000 miles per second. They are formed also in connection with electrical discharges. They constitute the so-called beta rays, which are continually being given off by the metal radium as well as by uranium, thorium, and some other rare metals with high atomic weights. Those corpuscles do not remain free, but almost immediately unite with each other to form new atoms and molecules, in some cases forming molecules of elementary bodies which differ in character from the elements from which they (the corpuscles) have proceeded. Thus, the element helium has been shown to be derived from and to be what we may call a decomposition product of radium. Truly the old Alchemists, who have been held up to derision and scorn for hundreds of years, were not so very far wrong after all when

they asserted the possibility of transmuting the baser metals into gold! These corpuscles, as I have said, are all exactly similar to each other in every respect, from whatever source they are emitted, showing us that the fundamental basis of all matter is exactly the same. So we see that all the different substances which we know, all the various elementary bodies and compounds which exist, are really formed of one and the same kind of matter, are built up of the same corpuscles, and owe their differences simply to their atoms containing a greater or smaller number of these corpuscles, and also possibly to the arrangement of the corpuscles in the atoms being different. All the diverse forms of matter have therefore probably been evolved from one primæval type. The elements with simpler and higher atoms may have been produced first under conditions of intense heat; as things cooled down, elements with atoms of greater mass were probably formed; and, when temperate conditions obtained, all the various compound bodies, inorganic first and then organic, which are found upon the face of our Earth.

Sir Norman Lockyer claims to have discovered by means of the spectroscope that in the very hottest stars elements of the lowest atomic weight, such as hydrogen and helium, and a substance giving only some of the lines of hydrogen, and which he considers to be an element of still lower atomic weight, are predominant. As we go downwards in the scale of temperature, carbon, nitrogen, oxygen, silicon, etc., appear; while in the stars of lowest temperature we get calcium, manganese, iron, and the heavier metals. He also points out that many of the elements as they exist in the Sun and stars are different from and simpler than the analogous elements as they occur on our earth. For example, in what is called the reversing layer of the Sun, the spectrum of iron is represented by nearly 1,000 lines, while in the chromosphere, a much hotter part, the iron spectrum is reduced to two lines. And in sun-spots still another set of iron lines are found. Magnesium, also in the Sun, gives a simplified spectrum, and probably exists there in a dissociated form. In the spectrum of calcium a certain line in the blue is very prominent, and two other lines called the *H* and *K* lines are also seen. Now, in the spectrum from some parts of the sun the *H* and *K* lines are seen, and the blue line is absent or very thin. In other parts of the sun the blue line is prominent, and the *H* and *K* lines are very faint or invisible. This looks as if in the Sun the element calcium was decomposed into at least two substances. Evidence of the same kind is found in the stars. We have simplified spectra,

not only of iron, magnesium, and calcium, but of other metals such as titanium, copper, manganese, etc. To these, which we may call metals in the making, the prefix 'proto-' has been applied. Thus we have proto-iron, proto-calcium, proto-manganese, etc. Professor Pickering, of Harvard University, recently discovered some lines in the spectrum of a star in the constellation Argo which he identified with some of the hydrogen lines, and considers them to be produced by hydrogen of a very rudimentary atomic type, or proto-hydrogen. Afterwards proto-hydrogen was discovered in other stars, but it seems to be confined to those celestial bodies which appear to be the hottest. This is to be expected, as the atom of this element is probably much smaller and simpler even than that of hydrogen.

Thus by inorganic evolution we mean for one thing that the elements as we know them are really compound bodies; that the atoms have not been specially created as such and are not indivisible, but made up of a great number of very much smaller bodies which we call corpuscles; that these corpuscles are all exactly similar to each other and unchangeable; and that the more complex atoms have gradually been evolved from lighter and simpler atoms, and these again from still simpler forms, back perhaps to the very simplest of all, the corpuscles themselves in a free state. This process must have taken almost an infinity of time, so inconceivable a period indeed that the millions of millions of years required for organic development on our earth would be exceedingly short in comparison. There is good reason to believe that the governing agent in this development is simply temperature; indeed, that the evolution itself results mainly, if not entirely, from progressive loss of temperature. As the temperature falls, more and more complicated atoms and molecules are produced, until finally, as happened on our Earth many million years ago, the temperature falls at length sufficiently to allow of the building up of very complex forms of matter; then simple organisms are produced, and the cycle of organic evolution begins.

Let us now turn to evolution on a grander scale, the evolution of our Earth and all the various bodies, large and small, which exist in the immensity of space. And first let me sketch briefly some of the things which we know concerning these different masses of matter. Throughout the Universe, scattered through almost infinite space, are found an immense number of bodies varying in size to a most amazing extent, from the merest speck of meteoric dust to mighty orbs perhaps many millions of

miles in diameter, and enormous accumulations of nebulous material, so vast that it would take light, travelling as it does at the rate of 185,000 miles a second, many days, months, or even years to traverse them. Let us begin with the Solar System. Our Earth is a globe about 8,000 miles in diameter, for the most part solid or practically so from centre to circumference. This solid mass is partially surrounded by an envelope of liquid, or water, and outside this again we have an envelope of gaseous matter forming the atmosphere. We know that the interior of the solid globe is in an intensely heated condition, and there is every reason to believe that in ages long past the heat of the Earth was very much greater than it is now. The planet Venus is probably in about the same physical condition as the earth. Mars is considerably smaller and contains less water and air in proportion to its size, and has probably lost more of its internal heat. In the Moon we have a body much smaller still, and apparently composed altogether of solid material, there being no appreciable watery or gaseous envelope; and probably it has almost entirely parted with its primæval heat. Most of the other satellites and the asteroids, bodies still smaller, may be in the same physical condition as the Moon. Then we have meteors, small pieces of dead cold matter which travel round the Sun in very eccentric orbits, and probably enter to some extent into the composition of comets. The rings of Saturn are supposed to be composed of bodies of this kind. Then we come to the larger planets, Jupiter, Saturn, etc., which are very much larger than the earth and of much smaller density, and are therefore believed to be extremely hot. They are considered to be composed of matter in a liquid state, at any rate for the most part, and they are surrounded by very deep and dense gaseous envelopes. Then we have the Sun, the centre of our system, 860,000 miles in diameter, of enormous size compared to his dependants, and believed to be an immense mass of dense and intensely-heated matter in a gaseous condition. Thus we have in our system, one very large central body which is very highly heated and gaseous in constitution; several smaller bodies which are less heated and composed of liquid and gaseous matter; then still smaller bodies which are mostly solid with liquid and gaseous envelopes surrounding them, and which are only heated in their interiors; and finally smaller bodies still, which are entirely solid and quite cold. It is difficult to resist the conclusion that these masses of matter were once all in the same condition, all intensely heated and gaseous, and that their present differences of constitution and

temperature are simply due to the smaller bodies having cooled more rapidly than the larger ones. In fact, one may with probability suppose that they all formed part of one very large and diffused collection of matter, either gaseous or meteoric, which extended at least as far out from the centre as the orbit of Neptune. And this conclusion is rendered all the more probable by the fact that the spectroscope informs us that the Sun is composed of very much the same materials as those which we find upon our earth.

Let us now glance at the innumerable multitude of Stars and Nebulæ.

It has been said that our Sun is a star, and that is doubtless true; and it is also true that every star is a sun. But the great majority of the Stars differ from our Sun in many very important respects. Indeed, probably no two stars are exactly alike. Nature does not repeat herself. Everything that comes from her workshop possesses its own peculiarities. No two leaves are exactly alike; no two men are exactly alike; and, so far as we can judge, no two stars are exactly alike. The number of the stars is exceedingly great. It has been estimated that the stars visible in the most powerful telescopes number at least 100 millions, and possibly even double that number; and they vary extremely in size and brilliancy, many far surpassing our Sun in magnitude and light, and many being very much smaller. For example, Canopus is probably not less than 15 to 20 millions of miles in diameter, and has been estimated to give at least 22,000 times the light of the Sun. On the other hand, one of the sun's nearest neighbours, a small star in the constellation of the Great Bear, is estimated to emit only $\frac{1}{2\,0\,0}$ part of the sun's light, and to have a mass smaller in proportion. Indeed, the great majority of the stars which are nearest to us, with the exceptions of Sirius, Procyon, and Alpha Centauri, are much smaller and less luminous than our Sun. And yet on the whole our Sun is rather a small star than otherwise. The stars are not scattered through space with any approach to uniformity. In that region of the universe which we occupy, the stars are comparatively very sparsely distributed, our nearest stellar neighbour being Alpha Centauri, whose light takes four years and four months to reach us, travelling at the rate of 185,000 miles a second, across a distance of about 25 billions of miles. But in some other regions the stars are situated very much nearer to each other, especially in star clusters and in the Milky Way. As I have said, the great majority of the stars are very unlike our Sun in

many important respects. Most of them seem to be of less density and give out more light in proportion to their mass than the Sun does. Professor Newcombe says in his book on 'The Stars': "The stars in general are not models of our Sun, but have a much smaller mass in proportion to the light they give than the Sun has. They must therefore have either a less density or a greater surface-brilliancy." And again: "We must conclude that at least the brighter stars are in general composed of matter much less dense than that of the Sun. Many of them are probably even less dense than air, and in nearly all cases the density is far less than that of any known liquid." Most of them would therefore seem to be in an earlier stage of development. But the reverse is the case with a certain number of the less brilliant stars, some of which are more massive in proportion to their light than the Sun is.

A very large number of the stars are not single like our Sun, but double; that is, composed of two bodies revolving round each other, or rather round a common centre. These two bodies may be nearly equal, or they may differ very much either in size or in brilliancy or in both. Sometimes the more massive component is the more brilliant, but quite as frequently the reverse is the case. Sometimes the components of a double star are comparatively far apart, and travel in orbits which may take as long as 300 or 400 years to traverse, and in other cases they are so close together as almost actually to touch, and revolve round each other in a few days or even hours. These close doubles appear to be in an early stage of development, and in many cases their mass is very small in proportion to their luminosity. In one instance the mean density of the two bodies has been stated to be no greater than that of our atmosphere. Double stars are very common: in fact, it has been said that the great majority of the stars are double.

There are also triple stars, quadruple stars, multiple stars. In some of these cases of multiple stars it has been shown that the bright stars are associated with dark bodies, sometimes of much greater mass than their lucial companions. Thus the existence of dark stars is proved. In such cases we have a sort of reversed Solar System with a large dark body in the centre, and small bright secondary orbs circulating round it. We may conceive the mode of formation of double stars to be as follows:—a very tenuous fluid mass, rotating on its axis very rapidly, becomes disrupted or split into two parts, which continue rotating round each other, at first in close proximity; then as time goes on the

two portions keep on moving further and further apart, under the influence of tidal friction. All stages of this process are represented among the double stars.

Then we have star-clusters, which are collections, often on a very grand scale, of stars and star-like bodies, large and small, united in one system and probably of common origin. One of the best known examples is the Pleiades, which contains a great number of stars, mostly very small, though at least 50 or 60 of them are much larger than our Sun. These clusters often contain many thousands of stars, and the stars in them are often comparatively very close together. In one cluster the stars have been estimated to be on an average distant from each other about $\frac{1}{100}$ part of the distance of the Sun from his nearest neighbour.

Our Sun shines with a fairly constant light, but many of the stars are very variable in lustre either in short or in comparatively long periods. The period of variability may range from a few days or even hours to several years. Sometimes the variations are due to a bright star being partially eclipsed by a comparatively dark companion, but in other cases there seems to be a real variation in the quantity or quality of their light. Variable stars appear mostly to be in a comparatively early stage of their existence. They are all at enormous distances from us, and there is reason to believe that the conditions which favour instability of light do not exist amongst what we may call the Sun's next-door neighbours.

New or Temporary stars have made their appearance at various times. Having been before so small as to escape observation, they suddenly blaze out with great brilliancy, and after a period of brightness lasting some weeks or months gradually fade away to insignificance. One has been described which rivalled Venus in lustre. They seem to be comparatively small bodies, which from some unknown cause suddenly develop greatly increased heat and light, and become surrounded by incandescent gases. Some of those most recently observed appear after the outburst to have settled down to the condition of nebulæ. They mostly occur in the Milky Way at immeasurable distances from us. It has been suggested that the collision of two dark bodies may be the cause of the sudden outburst of light.

The Milky Way encircles the Sidereal Heavens like a great zone or irregular belt. It sends out streamers or branches in various directions, and is intersected by rifts or gaps. It consists of an innumerable multitude of stars in much closer proximity to each other than in other parts of the heavens. It is considered

to be on the outer part of the visible universe, and really to form an irregular ring of comparatively dense stars. The Sun is not very far from the centre of this ring, from which it is separated by an enormous interval of space sprinkled with stars mostly at relatively considerable distances from each other. The interval between our Sun and the Milky Way is so great that Newcombe estimates that it takes light no less than 3,200 years to cross it, and some astronomers consider the distance very much greater. The Milky Way is composed of an enormous aggregate of clusters of stars relatively close together. It contains stars of all sizes: from first magnitude stars, whose real dimensions, shining as they do across such a stupendous gulf, must be almost absolutely inconceivable, down to a host of minute stars very much smaller than our Sun. It is here that the greatest number of variable and temporary stars occur, and many of the stars and clusters found here are swathed in dim clouds of nebulous matter. It is also here that the very hottest and presumably the youngest stars are found. The energies at work in the Milky Way must be tremendous, and the cosmical conditions which prevail there must be very different from any which obtain in our part of the universe. A very highly-energised and much less stable state of things seems to exist in that mysterious girdle which encircles, so far as we can see, the whole Scheme of Creation.

Nebulæ are dim patches of cloudy light, as a rule only visible through the telescope. Sometimes they are rounded or annular in shape; sometimes they present a more or less spiral form; and sometimes they are of very irregular shape and complex constitution. Sometimes nebulous matter surrounds a star, forming what is called a nebulous star. Sometimes the larger nebulæ contain bright points which are perhaps stars in process of formation. Most of them are of really enormous size, covering a space at least thousands of times as large as the Solar System, while some, such as the great nebula in Orion and the nebula in Andromeda, are immensely larger even than this. As these objects are perfectly transparent, the matter of which they are formed must be of extreme tenuity. They are usually supposed to consist of very tenuous incandescent gaseous matter. Sir Norman Lockyer, on the other hand, thinks that nebulæ are vast collections of meteorites moving amongst themselves with extreme rapidity and continually coming into collision with each other and so producing heat and light. The nebulæ are all extremely distant objects, and though found all over the

heavens are most numerous in the parts remote from the Milky Way.

The stars are of various colours. Some shine with a white or bluish-white light, like Sirius and Vega; some are yellowish, like Arcturus and our Sun; some are reddish, like Antares; and some few are of a deep red colour. By means of the spectroscope we have been enabled to analyze the light of the stars, and in the main we find the elements which compose them to be similar to those which occur in our earth. Yet each star-spectrum presents its own peculiarities, and no two spectra are exactly alike. Stellar spectra may be divided into several main types, some of which I will mention, first premising that there are all kinds of intermediate forms, giving us indeed an unbroken series. There are gaseous or bright-line stars, which have spectra showing a band of continuous light crossed, not only by dark, but by bright lines mostly of hydrogen and helium. Then there are the so-called helium stars, which have a bright continuous spectrum crossed by fine dark lines of helium and hydrogen. These two types are only found in the Milky Way. Then there are the Sirian stars, the most noticeable thing about their spectra being the lines of hydrogen, which in some of them are very thick; their spectra are also crossed by fine lines due to metallic vapours. These are most numerous in the Milky Way. All these three varieties are white stars. Then we have the Solar stars, like the Sun, which are yellowish, and present spectra delicately ruled from end to end by absorption lines of metallic vapours; the lines of hydrogen are also there, but are not so prominent as in the Sirian stars. Besides these we have reddish stars, called by Lockyer Antarian stars, whose spectra are crossed by dusky bands or flutings of absorption, as well as fine lines. Finally, we have the deep red stars called by Lockyer Carbon stars, from lines and flutings due to carbon compounds being prominent in their spectra. The white stars are considered to be the hottest, the yellowish stars of medium temperature, and the red the coolest.

Now let us consider for a moment what all this means. We have in the universe of stars an immense number of bodies all differing from each other, not only in size and in rapidity of motion, but in temperature and in physical constitution. They form, indeed, a complete series, all the different forms passing gradually into each other. Let us run over them. First we have a nebula, where matter exists in its most diffuse form; then a stellar nebula, which is somewhat more condensed; next

a nebulous star, then a bright-line star, a helium star, a Sirian star, then a solar star like our Sun, a red star whose materials are cooler and denser, and finally a dark star whose matter has become cold and solid. On a still larger scale we have one of the great nebulæ, then a nebula with luminous points in it, next a nebula containing undoubted stars, and finally a star-cluster. And we must remember that all these different forms shade off gradually into each other. Add to this the fact that all these bodies seem in the main to be composed of the same materials. Can we doubt that the history of all these bodies is practically similar, that every star has had a beginning, and in process of time will have an end, and that the differences amongst the celestial bodies are mostly due to their being at different stages of their existence? In the Solar System we have a number of bodies all related together and presumably of much the same age, though at different stages of their development; while in the Universe of Stars we have an immense multitude of bodies apparently unconnected together, or belonging to different stellar systems, not only at very different stages of existence, but almost certainly of very different absolute ages. Some of these celestial objects are, we may say, in nebulous infancy; others are in their prime, at the height of their glory and brilliancy; while others, again, are in a condition of stellar old age. It is worth noting that all our Sun's immediate neighbours are, like him, in the middle period of their existence, while the youngest and the very oldest stars are all or nearly all in the Milky Way. The nebulæ, again, are scattered all over the heavens, though most numerous in those parts far from the Milky Way, and are all at incalculably remote distances from us.

Two different hypotheses of the mode of development of the Universe have been propounded. According to Laplace's Nebular Theory the Solar System was at some remote period a great nebula extending far beyond the orbit of Neptune. This nebula rotated on its axis. As the great mass cooled it contracted and became more condensed in its central parts. As it contracted it rotated more rapidly, and owing to the influence of centrifugal force the outer part separated as a ring. The inner portion continuing to contract, a second ring was formed in the same way. In this manner the nebula finally separated into a series of rings, all revolving in the same direction around each other and around a central nebulous mass. The matter of each ring continued to cool and condense, condensing in some parts more rapidly than in others. The effect of this would be to draw into a single mass

all the materials of the ring, and so a planet was formed. In one instance there was a number of small centres of condensation, and the zone of asteroids between Mars and Jupiter was the result. This process was repeated in the case of the incipient planets, and satellites were formed in the same way. The central nebula kept on contracting, and finally formed the Sun. All these bodies continued condensing and losing heat, till they finally attained their present condition. Against this theory it may be stated that no nebula has yet been proved to rotate on an axis. The fact that in the case of double stars the more massive body is often the darker, seems also a difficulty in the way of accepting this theory.

Sir Norman Lockyer has lately promulgated another theory of the origin of the Sun and Stars, in many respects very different, which he calls the Meteoric Hypothesis. He considers that a nebula is not essentially a mass of incandescent gas, but rather an immense cloud of meteorites. These meteorites, composed of metals and metalloids much as we know them, are at comparatively considerable distances from each other and move amongst themselves with extremely great rapidity. There are continual collisions amongst them, causing their partial conversion into vapour and attended by the production of heat and light. In process of time, under the action of gravity, a condensation takes place in the centre of the meteor swarm, forming the nucleus of a star. Other smaller condensations may occur in other parts of the nebula, forming the nuclei of planets. These condensations, being continually bombarded by meteoric matter, grow not only larger but hotter and hotter, till at length the meteorites are mostly used up and the central bodies become converted into spheres of intensely hot incandescent gas. The central mass forms a sun, and the smaller bodies become planets which circulate round their primary under the influence of gravity. As the sphere contracts it becomes hotter and hotter till it reaches the highest attainable temperature, and the condition of things we find in the hottest stars obtains, where he estimates the temperature at about 30,000° C. As this process goes on the elements become simplified and dissociated, till only hydrogen, helium, proto-hydrogen, and some other proto-elements remain. The history of the star henceforward is that of a cooling body. As it continues to get cooler and cooler, the metallic elements begin to appear and we get a spectrum something like that of Sirius; as the cooling process advances it attains the condition of our Sun, then that of the deep red

stars, and finally gets cold and becomes a dark star. The history of a planet is much the same, only being a smaller body it parts with its heat more quickly, and reaches the dark stage more rapidly. In a great nebula such as the nebula in Orion, many condensations would occur in different parts of the nebula, and it would finally be converted into a star-cluster.

I believe that the idea of meteorites in rapid motion constantly coming into collision with each other and thus being partially converted into incandescent gases originated with the late Professor P. G. Tait of Edinburgh University, who suggested this as an explanation of a comet's tail. He also held that nebulæ consist of clouds of stones in an atmosphere of hydrogen which is rendered incandescent by continual collisions among the meteorites. The late R. A. Proctor was also one of the first to suggest the meteoric origin of the Solar System. He says in 'Other Worlds than Ours,' published in 1870: "Under the continued rain of meteoric matter it may be said that the Earth, Sun, and Planets are growing. Now the idea obviously suggests itself that the whole growth of the Solar System from its primal condition to its present state may have been due to processes resembling those which we now see taking place within its bounds." And again: "It seems to me that not only has this general view of the mode in which our System has reached its present state a greater support from what is now actually going on than the Nebular Hypothesis of Laplace, but that it serves to account in a far more satisfactory manner for the principal peculiarities of the Solar System."

The late Dr. Croll, in 'Stellar Evolution,' published in 1889, elaborated what he called the "Impact Theory of Stellar Evolution," originally proposed by him in 1868. According to this our Sun and similar bodies were formed by the collision of two dark stellar masses travelling through space at a speed of at least 200 miles a second. Under the influence of gravitation their speed became gradually accelerated as they approached each other, till at the moment of impact they were rushing together at the rate of at least 476 miles a second. Such a collision instantaneously shivered them into fragments, and the enormous quantity of incandescent gases generated at the same time dispersed those fragments in all directions. By constant collisions with each other the solid particles became gradually converted into gases, and at length came to occupy a space at least as large as the Solar System. This great mass gradually contracted, and its subsequent history was that

indicated by Laplace's Nebular Hypothesis. Possibly such a collision of two dark bodies might account for the origin of a nebula, even if we suppose with Lockyer that a nebula is essentially a great swarm of meteorites; especially as the discovery of radio-activity and the immense stores of energy shut up in the atom render it unnecessary to postulate such a high rate of speed in the colliding masses.

Lockyer claims to have discovered that the stars having thin hydrogen lines and thick metallic lines in their spectra are increasing in temperature, while those with thick hydrogen lines and thin metallic lines are getting cooler. In accordance with this he has arranged a series illustrating the different stages in what he calls the life history of a star. First we have a nebula, then a nebulous star, next a reddish star like Antares, then through stages represented by the Pole Star, Alpha Cygni, Rigel, and the Orion stars, to some stars in the constellation Argo, which he considers the very hottest of all. Then as the temperature falls we get stages represented by Algol, Markab, Sirius, our Sun, Arcturus, a deep red star in the constellation Pisces, and finally a dark star. Thus he claims that as the Geologist, examining the various strata in the earth's crust from the oldest to the most recent formations, finds an ever-increasing complexity in the organic remains which they contain, so the Astronomer, analyzing the light of the stars from hottest to coldest, finds an increasing complexity in the so-called elements he can detect in them. And finally on the Earth, the only cold body we can examine, we find the thousands of elements and compounds familiar to Chemists.

Lockyer's theory is very fascinating, and much might be said in its favour, but it has not yet, I believe, been generally accepted by astronomers. Assuming it to be true, what becomes of the dark stars? Are they somehow or other, perhaps, as Croll suggested, by coming into collision with each other, eventually reconverted into a swarm of meteorites, and does the cycle recommence? Or is the Universe like a clock running down, and will a time come, infinite æons hence, when the last nebula shall have been converted into stars, when the last star shall have become dark and cold, and the whole universal Scheme of things a Chaos of darkness and death? We can hardly believe this. Though we can comprehend neither Infinity nor Eternity, still less can we picture to ourselves a Universe finite in space or time. And in any case we know that He who made the Universe can restore it, and we are told that a new Heaven and a new Earth will be the final abode of glorified Man.

One more thought is forced upon us. The vast period, billions on billions of years perhaps, which the inorganic evolution of the Solar System required, was but a necessary preparation for the organic evolution which followed so soon as our Earth became cool enough to allow of the formation of highly complex chemical compounds and fitted for the appearance of life. And organic evolution, which probably took many millions of years, was a necessary antecedent to and attained its highest development in the advent of Man. And when we survey, as well as we can, the various bodies of the universe, we note that the condition of most of them is very different from the state of our own Sun, and that there can only be comparatively very few of the stars at all fitted to have planets suitable for the abode of life circling round them. And the number of worlds where organisms of a highly specialized and complex character could be developed must be still more limited. So that although, on the one hand, the tendency of modern discoveries is to accentuate the insignificance of man, yet on the other hand there is much that seems to enhance his relative importance. We are told in the Book of Genesis that though man was formed of the dust of the earth he was also made in the image of the Deity.

I trust that you will pardon the many imperfections and shortcomings of this brief sketch of some of the most recent attempts to raise a corner of the veil which enshrouds the mystery of mysteries, the great Enigma of the Universe.

Let us remember, in the words of the poet:

"Our little systems have their day,
They have their day and cease to be;
They are but broken lights of Thee,
And Thou, O Lord, art more than they."

LARCH AT RUSSELLS, WATFORD, STRUCK BY LIGHTNING, 9TH JULY, 1905.

VII.

THE WEATHER OF THE YEAR 1905 IN HERTFORDSHIRE.

By JOHN HOPKINSON, F.L.S., F.G.S., F. R. Met. Soc., Assoc. Inst. C. E.

Read at Watford, 2nd April, 1906.

(PLATE I.)

REPORTS on the Rainfall in Hertfordshire for the last twenty-nine years have been published in our 'Transactions,' and some of the results of other meteorological observations in the county for nearly as long a time have been given. The latter were at first for one station only, Watford, and some years later for St. Albans, but, commencing with the year 1887, results for four or five stations have been given, for ten years under the title "Climatological Observations" and for eight years under that of "Meteorological Observations," other than merely climatological observations having for this period been included.

In the present paper the former "Reports on the Rainfall" and "Meteorological Observations" are combined under a new title, in order to avoid a certain amount of repetition and so economize space, for it is obvious that while a separate report has been given on the rainfall, that element of the weather could not be excluded from the report on general meteorological observations. For the same reason the discussion will not be so full as it has hitherto been, and with this change of treatment it has been thought desirable to adopt a more popular title.

In the table of monthly rainfall accompanying this report, from all the stations represented but two (Royston and Bulbourne) the daily return of the rainfall has been received. They number 51, being one more than for the previous year. The exclusion of all from which only monthly returns have been received, except the above, retained because in each of their districts there is only one other station represented, has reduced the total number of stations from 54 for the previous year to 53.

There are but few changes in the rainfall stations. The additions are Croxley Green in the Chess river-district, Stanstead Abbotts in the Upper Lea, and Hatfield St. Mary's in the Lower Lea. The losses are Wigginton and Cowroast, from which only monthly returns have been received, in the Bulbourne river-district; Great Gaddesden, in the Gade, from the removal of the observer; and Hadley, in the Lower Lea, from the same cause. Summerhill, Barnet, being found to be in the Brent district, has been transferred to it from the Lower Lea.

The stations for which other meteorological observations are given are the same as for several years past. In all cases the hour of observation is 9 a.m., and all the observations are entered to the same day, except the rainfall and maximum temperature, which are entered to the previous day. Shade temperatures only

are given; those for Bennington, Berkhamsted, and St. Albans being from thermometers in Stevenson screens, and those from New Barnet from thermometers under a Glaisher stand.

Information as to the stations has been given in my paper on "The Climate of Hertfordshire" in the eleventh volume of our 'Transactions' (pp. 125–126). The averages with which the results are compared are those for the twelve years 1887–1898 as there given, except for the rainfall, which is compared with the average for the sixty years 1840–1899.

TABLE I.—*Results of Climatological Observations taken in Hertfordshire in the Year* 1905.

Stations	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max				
	°	°	°	°	°	°	%		ins.	
Bennington	48·4	41·5	55·3	13·8	20·5	81·5	83	7·6	22·51	197
Berkhamsted ...	48·5	41·2	55·9	14·7	20·1	81·3	82	7·1	24·33	179
St. Albans	48·5	41·8	55·2	13·4	19·3	81·5	81	6·9	24·15	186
New Barnet	50·2	42·2	58·2	16·0	16·7	85·8	81	6·5	25·88	162
County	48·9	41·7	56·2	14·5	16·7	85·8	82	7·0	24·22	181

The year 1905 was, on the whole, warm and dry; the air was of average humidity, the sky rather more cloudy than usual. Though the rainfall was deficient in quantity, in frequency it slightly exceeded the average, and there were many heavy falls.

The mean temperature was 48·9°, being 0·6° above the average; the mean daily range was 14·5°, being 1·4° below the average, the excess of temperature thus being due to the warmth of the nights. The rainfall was 23·48 inches, being 1·29 ins. below the average for the decade 1890–99, and 2·66 ins. below that for the 60 years 1840–99. The number of wet days was 169, being one more than the average for the 30 years 1870–99.

Compared with the average, January and December were warm months, and February, March, and July were very warm; August and September were rather cold, and October and November were very cold. The air was dry in January, July, and October, and very dry in May; it was moist in November and December. The sky was bright in January, February, May, and July; it was cloudy in June, August, and September, very cloudy in April and December, and rather cloudy in March. March and June were wet months, and April, August, and November were rather wet; all the other months were dry, October having the greatest defect in rainfall from the average. Rain fell on many days in March, April, August, and November, and on very few days in May and July.

TABLE II.—*Means of Climatological Observations (with Extremes of Temperature) taken at Bennington, Berkhamsted, St. Albans, and New Barnet, during the Year* 1905.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes					
	Mean	Min	Max.	Range	Min	Max.			Amount	Days
	°	°	°	°	°	°	%		ins.	
Jan.	37·4	31·7	43·1	11·4	16·7	55·8	86	6·5	1·30	17
Feb.	41·4	36·4	46·4	10·0	27·6	54·8	86	6·2	1·00	15
March	44·6	37·7	51·5	13·8	22·7	61·3	85	7·3	3·27	22
April	46·0	38·8	53·2	14·4	27·2	64·9	79	8·0	2·05	20
May	52·3	41·9	62·7	20·8	29·2	79·4	67	5·4	1·16	7
June	59·2	50·9	67·6	16·7	44·4	82·0	77	7·6	3·46	15
July	65·5	55·6	75·5	19·9	43·9	85·8	71	5·7	1·66	9
August	59·9	51·0	68·7	17·7	40·8	79·9	75	7·3	3·08	19
Sept.	55·6	48·3	62·9	14·6	38·5	74·8	83	7·1	1·79	13
Oct.	44·9	37·8	52·1	14·3	23·5	61·0	84	6·5	1·52	17
Nov.	40·5	34·7	46·4	11·7	17·7	54·8	93	7·9	2·93	19
Dec.	39·5	35·4	43·6	8·2	26·2	56·8	93	8·6	1·00	14
Year	48·9	41·7	56·2	14·5	16·7	85·8	82	7·0	24·22	181

TABLE III.—*Means of Climatological Observations (with Extremes of Temperature) for the Seasons of* 1904–1905.

Seasons	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes					
	Mean	Min.	Max.	Range	Min	Max.			Amount	Days
	°	°	°	°	°	°	%		ins.	
Winter	39·1	33·9	44·3	10·4	16·7	56·6	88	7·2	4·42	53
Spring	47·6	39·5	55·8	16·3	22·7	79·4	77	6·9	6·48	49
Summer	61·5	52·5	70·6	18·1	40·8	85·8	74	6·9	8·20	43
Autumn	47·0	40·3	53·8	13·5	17·7	74·8	87	7·2	6·24	49

The winter of 1904–5 (Dec. to Feb.) was very mild, chiefly owing to the warmth of the nights, the mean daily range of temperature therefore being small. The air was rather dry and the sky less cloudy than usual. The rainfall was very small, being but little more than half the average, but the number of days on which it fell closely approached the average.

The spring (March to May) was warm, owing almost entirely to the warmth of the nights, the mean daily range of temperature being very small for the season. The air was dry and the sky rather more cloudy than usual. The rainfall was heavy, exceeding the average by more than 40 per cent., and it fell on a large number of days.

TABLE IV.—*Climatological Observations taken at* BENNINGTON HOUSE, BENNINGTON. *Latitude:* 51° 53′ 45″ N. *Longitude:* 0° 5′ 20″ W. *Altitude:* 407 *feet. Observer:* REV. J. D. PARKER, LL.D., F.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	37·3	32·1	42·4	10·3	20·5	52·5	87	7·5	1·42	14
Feb.	40·4	35·6	45·2	9·6	28·7	53·7	88	6·9	·81	17
March	44·1	37·5	50·7	13·2	26·4	60·0	87	7·6	2·69	26
April	45·1	38·0	52·3	14·3	28·0	61·8	81	8·9	1·72	20
May	51·7	42·0	61·4	19·4	31·8	78·8	67	6·1	·85	9
June	58·7	50·6	66·7	16·1	44·4	77·8	78	8·2	3·32	14
July	65·0	55·3	74·8	19·5	47·5	81·5	71	6·8	1·78	9
August	59·6	51·3	67·9	16·6	44·0	74·5	77	8·0	3·68	22
Sept.	55·4	48·3	62·4	14·1	41·4	73·0	87	7·5	1·68	13
Oct.	44·4	37·7	51·1	13·4	29·0	58·8	85	6·9	1·41	16
Nov.	40·3	34·9	45·7	10·8	24·9	53·7	95	8·4	2·31	22
Dec.	38·9	34·9	42·9	8·0	26·3	54·4	95	8·6	·84	15
Year	48·4	41·5	55·3	13·8	20·5	81·5	83	7·6	22·51	197

TABLE V.—*Other Meteorological Observations taken at Bennington by the Rev. Dr. Parker.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	30·295	36·4	35·0	37·3	38·7	5	13	97	7·4	7
Feb.	·191	39·6	38·1	40·0	40·4	2	15	76	7·5	5
March	29·779	43·3	41·6	42·6	42·6	2	12	134	10·3	2
April	·891	45·4	42·8	46·2	46·3	0	14	97	11·0	1
May	30·158	53·5	48·1	53·4	52·8	1	11	239	14·4	1
June	29·994	59·1	55·4	60·0	59·3	1	19	168	15·5	6
July	30·077	65·6	60·2	66·2	65·5	5	11	242	14·2	0
August	29·927	59·9	56·0	61·9	62·4	2	11	160	11·0	1
Sept.	30·006	55·7	53·7	57·3	58·2	0	18	120	10·2	1
Oct.	·053	44·6	42·6			6	15	107	9·3	2
Nov.	29·740	39·6	39·0			2	18	53	6·8	12
Dec.	30·267	38·4	37·8			2	23	30	5·2	16
Year	30·031	48·4	45·9			28	180	1523	15·5	54

TABLE VI.—*Climatological Observations taken at* ROSEBANK, BERKHAMSTED. *Latitude:* 51° 45′ 40″ N. *Longitude:* 0° 33′ 30″ W. *Altitude:* 400 *feet. Observer:* EDWARD MAWLEY, F.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	37·6	31·8	43·3	11·5	20·1	53·4	87	6·4	1·15	10
Feb.	41·5	36·5	46·5	10·0	27·6	54·6	86	6·8	1·12	13
March	44·4	37·4	51·5	14·1	25·3	59·6	86	7·2	3·51	20
April	45·7	38·4	52·9	14·5	29·2	61·2	80	8·1	2·05	20
May	51·7	41·1	62·4	21·3	29·2	77·8	66	5·3	1·29	8
June	58·5	50·5	66·5	16·0	45·1	77·8	78	7·8	3·51	16
July	64·8	55·1	74·5	19·4	43·9	81·3	72	5·6	1·02	11
August	59·2	50·6	67·7	17·1	44·4	75·4	73	7·2	2·67	18
Sept.	54·9	47·2	62·7	15·5	38·5	72·5	83	7·4	1·93	13
Oct.	44·4	36·9	51·9	15·0	25·0	57·2	85	6·6	1·86	18
Nov.	40·0	33·5	46·4	12·9	23·2	53·7	95	7·6	3·12	17
Dec.	39·7	35·2	44·2	9·6	26·2	54·2	94	8·6	1·10	15
Year	48·5	41·2	55·9	14·7	20·1	81·3	82	7·1	24·33	179

TABLE VII.—*Other Meteorological Observations taken at Berkhamsted by Mr. Mawley.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	30·289	36·1	34·7	36·3	38·7	8	12	75	6·9	9
Feb.	·182	39·7	38·0	39·8	40·7	2	15	72	6·9	4
March	29·750	43·2	41·4	43·1	43·3	3	12	123	9·7	3
April	·865	45·4	42·7	47·4	47·6	3	16	97	11·1	4
May	30·149	53·6	47·9	54·4	53·4	3	8	234	13·8	1
June	29·972	58·3	54·7	61·0	59·6	1	14	156	14·3	6
July	30·070	64·9	59·8	66·2	64·9	4	4	243	13·3	0
August	29·905	59·9	55·4	62·0	62·7	1	11	176	10·8	1
Sept.	·991	55·6	53·0	57·3	58·7	4	12	118	10·5	2
Oct.	30·045	43·8	41·9	47·4	50·7	8	10	100	8·9	5
Nov.	29·709	39·1	38·5	41·5	44·2	2	14	57	6·8	13
Dec.	30·251	38·3	37·6	40·4	42·1	1	23	33	4·9	17
Year	30·115	48·2	45·5	49·8	50·9	41	147	1484	14·3	65

TABLE VIII.—*Climatological Observations taken at the* HERTFORDSHIRE COUNTY MUSEUM, ST. ALBANS. *Latitude:* 51°45′15″N. *Longitude:* 0° 19′ 56″ W. *Altitude:* 389 *feet. Observer:* JOHN HOPKINSON, V.P.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	37·5	32·1	43·0	10·9	19·3	52·4	85	6·6	1·27	10
Feb.	41·3	36·4	46·2	9·8	28·6	53·9	85	6·2	·91	15
March	44·3	37·9	50·6	12·7	27·2	61·1	83	7·3	3·41	22
April	45·4	39·0	51·9	12·9	30·5	61·7	78	7·9	2·48	21
May	51·6	42·1	61·0	18·9	31·5	77·3	67	5·2	·69	8
June	58·4	50·9	65·9	15·0	45·7	78·3	75	7·5	3·88	17
July	65·2	55·8	74·6	18·8	47·1	81·5	71	5·7	1·30	9
August	59·4	51·2	67·6	16·4	42·9	75·7	74	7·1	2·96	18
Sept.	54·9	48·6	61·2	12·6	40·7	72·7	80	6·9	1·83	13
Oct.	44·7	37·9	51·4	13·5	29·0	58·3	84	6·4	1·46	17
Nov.	40·5	35·1	45·9	10·8	24·6	52·6	92	8·0	2·82	20
Dec.	39·0	34·9	43·1	8·2	27·5	54·4	93	8·6	1·14	16
Year	48·5	41·8	55·2	13·4	19·3	81·5	81	6·9	24·15	186

TABLE IX.—*Climatological Observations taken at the* GAS WORKS, NEW BARNET. *Latitude:* 51° 39′ 5″ N. *Longitude:* 0° 10′ 15″ W. *Altitude:* 212 *feet. Observer:* T. H. MARTIN, Assoc. M. Inst. C. E.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	37·2	30·8	43·6	12·8	16·7	55·8	85	5·6	1·35	10
Feb.	42·4	37·0	47·7	10·7	29·8	54·8	86	4·7	1·15	13
March	45·7	38·0	53·3	15·3	22·7	61·3	85	7·1	3·48	21
April	47·8	39·9	55·7	15·8	27·2	64·9	78	7·2	1·95	18
May	54·1	42·6	66·1	23·5	41·2	83·8	67	5·0	1·79	5
June	61·1	51·7	71·3	19·6	46·2	82·0	76	6·7	3·14	14
July	67·1	56·1	78·0	21·9	44·0	85·8	71	5·7	2·53	7
August	61·4	51·0	71·8	20·8	40·8	79·9	75	7·0	2·99	17
Sept.	57·2	49·1	65·3	16·2	39·2	74·8	81	6·7	1·72	13
Oct.	46·2	38·5	53·9	15·4	23·5	61·0	84	5·9	1·36	16
Nov.	41·4	35·2	47·6	12·4	17·7	54·8	90	7·4	3·48	17
Dec.	40·5	36·7	44·3	7·6	27·7	56·8	91	8·5	·94	11
Year	50·2	42·2	58·2	16·0	16·7	85·8	81	6·5	25·88	162

TABLE X.—HERTFORDSHIRE RAINFALL STATIONS, 1905.

District.	Station.	Observer or Authority.	Diameter of Gauge.	Height of Gauge above Ground.	Height of Gauge above Sea-level.	*
			ins.	ft. ins.	ft.	
1.	Royston—Melbourne Street	Joseph E. J. Phillips	8	0 11	201	T
,,	Odsey	H. George Fordham	5	1 0	256	
2.	Baldock—High Street	F. W. Langston Day	5	1 0	214	
3.	Preston—The Laburnums	R. de V. Pryor	8	2 6	480	
,,	Hitchin—Wratten	William Lucas	5	2 1	238	
,,	,, The Maples	William Hill	8	1 1	220	T
,,	,, The Chilterns	Francis Ransom	5	0 9	300	
,,	,, High Down	Joseph Pollard	5	1 1	422	
4.	Tring—Pendley Manor	Mrs. Williams	5	2 0	420	
,,	,, Bulbourne	Gordon C. Thomas	5	2 3	401	
5.	Croxley Green	S. Ingleby Oddie	5	0 7	250	T
6.	Berkhamsted—Fairhill	Miss M. Hopkins	5	1 0	548	
,,	,, Rosebank	Edward Mawley	8	1 0	401	
,,	,, Rose Cottage	W. E. Milner	5	1 0	334	
7.	H. Hempstead—Apsley Mills	J. Dickinson & Co.	24	0 9	260	
8.	Kensworth—The Grove	Miss S. Grace Jones	5	1 5	630	B
,,	Harpenden—Rothamsted	A. D. Hall	5	0 9	420	T
,,	St. Albans—Gorhambury	W. Newberry	5	1 0	423	T
,,	,, Herts County Museum	John Hopkinson	5	1 0	389	T
,,	,, Bone Hill	H. J. T. Broadwood	5	1 0	336	
9.	,, Hill End Asylum	G. Goodchild	5	1 0	295	T
,,	Elstree—Aldenham House	Edwin Beckett	10 sqr.	4 9	305	
10.	Watford—Weetwood	John Hopkinson	5	1 0	269	
,,	,, Lond. Orph. Asylum	Dr. O. C. Cockrem	5	1 0	231	T
,,	Colne Valley Water Works	W. Verini	5	1 2	220	
,,	Rickmansworth—Moor Park	Lord Ebury	5	2 0	340	
,,	Eastbury—Valeney House	H. Langford Lewis	5	1 0	360	T
,,	Northwood—Easby	Mrs. S. Fawcett	8	0 10	400	T
11.	Barnet—Summerhill	F. A. Milne	5	0 10	400	
12.	Welwyn—Danesbury	Col. A. M. Blake, C.B.	8	1 0	400	
,,	,, Bridge House	B. Wilfred Thomas	5	2 3	216	
,,	Datchworth Rectory	Rev. Andrew Amos	5	1 0	372	
13.	Weston—Weston Park	M. R. Pryor	5	0 8	470	T
,,	Bennington—Eileen Cottage	A. B. Legard	5	1 0	408	
,,	,, Bennington House	Rev. Dr. Parker	5	1 0	406	
,,	Knebworth—Manor House	Rev. S. R. Wigram	5	1 0	420	
14.	Therfield Rectory	Rev. John G. Hale	5	4 3	510	
,,	Throcking Rectory	Rev. C. W. Harvey	5	1 0	487	
,,	Buntingford—Hillside	G. Melville Smith	5	1 0	350	T
,,	,, Hamels Park	E. Wallis	5	1 0	400	T
15.	Much Hadham	T. Woodham Mott	5	1 0	222	B
16.	Harlow—Gilston Park	Edward Leach	8	0 6	175	T
17.	Hatfield—Holwell House	Wilfrid E. Laurie	5	1 6	175	T
,,	Hertford—Bayfordbury	H. W. Clinton Baker	8	1 2	250	
,,	,, Sewage Works	Metrop. Water Board	8	6 0	125	
,,	Ware—Fanhams Hall	Miss V. M. Croft	8	1 0	235	T
,,	,, Red House	Metrop. Water Board	5	4 0	115	T
,,	Stanstead Abbotts	E. H. Barlow	5	1 2	115	T
18.	Hoddesdon—Feildes Weir	Metrop. Water Board	8	3 8	95	T
,,	Broxbourne—Stafford House	G. J. Newbery	5	1 0	118	T
,,	Northaw—St. Just	Miss E. J. Poland	5	1 0	392	
,,	,, Hatfield St. Mary's Vic.	Rev. H. W. Southey	5	0 10	350	
,,	New Barnet—Gas Works	T. H. Martin	8	0 9	215	

* For explanation of these symbols see Vol. XI, p. 33.

TABLE XI.—RAINFALL IN

RIVER DISTRICT.			STATION.	JAN.	FEB.	MAR.
				ins.	ins.	ins.
OUSE	CAM	1. Rhee	Royston—Melbourne Street	1·03	1·21	2·19
			Odsey	1·18	1·01	2·05
	IVEL	2. Upper Ivel	Baldock—High Street	1·09	·96	2·24
			Preston—The Laburnums	1·32	·95	2·88
		3. Hiz	Hitchin—Wratten	1·13	1·00	2·81
			,, The Maples	1·10	·95	2·65
			,, The Chilterns	1·27	1·00	2·63
			,, High Down	1·03	·96	2·43
THAMES	THAME	4. Up. Thame	Tring—Pendley Manor	1·29	1·30	2·67
			,, Bulbourne	1·16	·95	3·06
	COLNE	5. Chess	Croxley Green	1·20	·67	3·35
			Berkhamsted—Fairhill	1·07	1·04	3·52
		6. Bulbourne	,, Rosebank	1·15	1·12	3·51
			,, Rose Cottage	1·18	1·11	3·52
		7. Gade	Hemel Hempstead—Apsley Mills	1·40	·93	3·87
			Kensworth—The Grove	1·15	1·28	3·30
		8. Ver	Harpenden—Rothamsted	1·29	·95	3·49
			St. Albans—Gorhambury	1·35	·88	3·49
			,, Herts County Museum	1·27	·91	3·41
			,, Bone Hill	1·16	·87	3·02
		9. Up. Colne	,, Hill End Asylum	1·24	·78	3·08
			Elstree—Aldenham House	1·36	·98	3·96
		10. Lo. Colne	Watford—Weetwood	1·18	·88	3·44
			,, London Orphan Asylum	·95	·67	3·42
			,, Colne Valley Water Works	1·11	·70	3·75
			Rickmansworth—Moor Park	1·02	·65	3·00
			Eastbury—Valeney House	1·01	·58	3·00
	BRENT		Northwood—Easby	1·14	·73	3·21
		11. Up. Brent	Barnet—Summerhill	1·51	1·00	3·69
		12. Mimram	Welwyn—Danesbury	1·36	·84	3·31
			,, Bridge House	1·43	·88	3·23
			Datchworth Rectory	1·36	·75	3·10
		13. Beane	Weston—Weston Park	1·34	1·07	2·75
			Bennington—Eileen Cottage	1·52	·92	3·18
			,, Bennington House	1·42	·81	2·69
			Knebworth—The Manor House	1·23	·79	2·91
		14. Rib	Therfield Rectory	1·19	1·25	2·32
			Throcking Rectory	1·31	·94	2·47
			Buntingford—Hill Side	·76	·76	2·46
			,, Hamels Park	1·34	1·10	2·66
	LEA	15. Ash	Much Hadham	1·34	1·19	2·47
		16. Stort	Harlow—Gilston Park	1·37	1·26	2·97
			Hatfield—Holwell House	1·28	1·01	3·05
		17. Upper Lea	Hertford—Bayfordbury	1·41	1·10	3·04
			,, Sewage Works	1·15	·84	2·49
			Ware—Fanhams Hall	1·26	1·01	2·66
			,, Red House	1·34	1·02	2·76
			Stanstead Abbots	1·25	1·02	2·62
		18. Lower Lea	Hoddesdon—Feildes Weir	1·30	1·14	2·60
			Broxbourne—Stafford House	1·54	1·42	3·59
			Northaw—Hatfield St. Mary's Vic.	1·51	1·26	3·74
			,, St. Just	1·30	1·01	3·13
			New Barnet—Gas Works	1·35	1·15	3·48
			Mean for the County	1·24	·97	3·04

ERTFORDSHIRE IN 1905.

L.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.	DAYS.
s.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	
52	1·15	3·32	·60	3·09	1·80	1·30	1·87	·78	20·16	160
52	1·04	3·24	1·31	2·97	1·67	1·25	2·39	·79	20·52	171
51	1·29	2·88	·98	4·47	1·94	1·37	2·57	·85	22·25	153
96	1·40	3·57	1·56	3·77	2·21	1·49	2·59	·67	24·47	143
84	2·00	3·29	1·25	3·25	2·02	1·49	2·40	·78	23·26	164
71	1·92	3·20	1·21	3·16	2·05	1·46	2·71	·83	22·95	161
79	1·80	3·21	1·26	3·16	2·03	1·44	2·69	·86	23·14	168
85	1·50	3·01	1·11	3·26	1·42	1·30	2·24	·98	21·09	167
17	1·94	4·19	1·51	3·27	2·18	2·00	3·60	1·17	28·29	192
10	1·47	3·70	1·22	2·86	2·04	1·73	3 03	·88	24·20	177
26	1·45	4·34	1·39	2·53	1·52	·98	3·15	·97	23·81	
01	1·32	3·40	1·01	2·57	2·08	1·80	3·03	·90	23·75	150
05	1·29	3·51	1·02	2·67	1·93	1·86	3·12	1·10	24·33	179
12	1·28	3·34	1·01	2·80	1·94	1·83	3·06	1·06	24·25	175
93	1·46	3·53	2·13	3·15	1·86	1·76	3·36	1·07	26·45	141
31	1·67	3·75	1·20	3·56	2·01	1·77	3·36	1·41	26·77	172
16	1·08	3·89	1·40	3·34	2·14	1·58	3·13	1·06	25·51	180
47	1·00	3·87	2·16	3·37	1·99	1·61	3·33	1·03	26·55	152
48	·69	3·88	1·30	2·96	1·83	1·46	2·82	1·14	24·15	186
29	1·00	3·78	1·35	3·08	1·70	1·43	3·29	1·03	24·00	180
00	·82	3·75	1·02	2·74	1·58	1·31	2·92	·95	22·19	141
12	·82	3·24	2·22	2·62	1·50	1·30	3·10	1·00	24·22	153
21	·80	3·61	1·16	2·37	1·67	1·48	3·21	1·08	23·09	187
07	·70	3·39	·83	2·29	1·32	1·31	3·01	1·07	21·03	162
99	·75	3·25	·93	2·28	1·38	1·29	2·95	·85	21·23	156
60	·63	3·35	1·12	2·49	1·26	1·09	2·39	·96	19·56	175
90	·66	4·23	·83	2·73	1·60	1·14	3·41	·97	22·06	166
94	·64	4·21	·90	2·67	1·54	1·32	3·50	1·13	22·93	163
06	1·39	3·27	2·65	3·06	1·75	1·36	3·61	1·06	26·41	163
04	·70	3·82	1·52	2·81	2·08	1·34	2·84	·92	23·58	156
17	·67	3·87	1·58	2·87	2·10	1·55	3·02	1·07	24·44	152
53	1·33	3·58	1·68	2·78	1·83	1·56	2·73	·79	23·02	
87	1·28	3·10	1·37	5·41	2·10	1·60	2·68	·99	25·56	186
16	·83	3·30	2·25	3·37	2·00	1·40	2·61	·89	24·43	184
72	·85	3·32	1·78	3·68	1·68	1·41	2·31	·84	22·51	197
05	·97	3·42	1·63	3·61	2·09	1·39	2·88	·94	23·91	176
13	1·17	3·58	·89	2·90	2·16	1·35	2·26	·99	22·19	188
12	·99	2·65	1·18	2·65	1·61	1·27	2·43	·90	20·52	181
63	1·34	2·36	1·36	3·01	1·57	1·15	2·13	·78	19·31	149
78	1·11	2·60	1·93	4·09	1·60	1·26	2·44	·99	22·90	
74	1·59	2·60	1·98	3·84	1·43	1·36	2·36	·83	22·73	155
00	2·05	3·13	1·67	3·59	1·81	1·62	2·53	·93	24·93	
96	1·13	3·39	1·79	2·57	1·63	1·25	2·73	·90	22·69	169
95	1·25	3·25	2·41	2·60	1·53	1·34	3·04	·85	23·77	176
51	1·29	3·10	2·06	2·68	1·28	1·18	2·41	·73	20·72	146
92	1·53	2·70	1·98	2·61	1·38	1·45	3·01	·94	22·45	175
67	·99	2·57	2·07	3·43	1·53	1·39	2·60	·85	22·22	172
79	1·25	3·24	1·95	3·38	2·08	1·55	2·64	·87	23·64	
72	1·80	2·95	1·52	3·29	1·85	1·50	2·60	·86	23·13	169
97	1·90	2·93	1·78	3·13	2·03	1·71	3·17	1·03	27·20	160
98	1·17	3·40	2·13	2·91	1·88	1·46	3·41	·99	25·84	
06	1·35	3·30	2·36	2·87	1·84	1·39	3·25	·88	24·74	190
95	1·79	3·14	2·53	2·99	1·72	1·36	3·48	·94	25·88	162
96	1·23	3·39	1·53	3·09	1·79	1·44	2·86	·95	23·49	168

The summer (June to August) also was warm, and from the same cause, the warmth of the nights, the days having a temperature only slightly above the average; the mean daily range again being small. The air was rather dry and the sky cloudy. The rainfall was very heavy, and the number of rainy days was above the average.

The autumn (Sept. to Nov.) was very cold, chiefly owing to the low temperature of the days, though the nights also were cold, the mean daily range of temperature again being small. The air was a little more humid than usual, and the sky was rather cloudy. The rainfall was below the average for the season, but there were more wet days than usual.

TABLE XII.—SUPPLEMENTARY TO TABLES X AND XI.

District.	Station.	Observer.	Gauge. Diameter.	Gauge. Height above Sea.	Rainfall.	Days.
			ins.	feet.	ins	
1.	Royston—Barley	R. A. Luck	5	300?	22·62	
,,	,, Workhouse	J. W. Wesson	5	217	21·80	164
6.	Tring—Wigginton	Rev. H. J. Burrell	5	710 ⊼	26·35	
,,	,, Elm House	E. J. Le Quesne	5	460	24·20	154
,,	,, Cowroast	G. C. Thomas	5	394 ⩚	27·60	148
	Berkhamsted—					
,,	,, Rosebank (M)	E. Mawley	8	401 ⩛	23·84	
,,	,, Rose Cottage (M)	W. E. Milner	5	334 ⩚	24·28	
7.	Chipperfield—L. Callipers	A. W. Rivington	5	407 ⊤	22·52	
8.	Harpenden—Rothamsted	A. D. Hall	8	420 ⊤	24·80	162
,,	,, ,,	,,	72 × 87	420 ⊤	26·44	179
10.	Watford—Weetwood (M)	J. Hopkinson	5	269 ⩚	22·87	
,,	,, St. Albans Road	H. Ruddle	5	250	19·68	
14.	Buntingford—Westmill	T. Greg	5	279 ⊤	22·60	172
17.	Hertford—Haileybury	P. H. Latham	8	270 ⊤	24·06	175
18.	Barnet—Grammar School	Rev. J. B. Lee	5	430 ⊤	25·88	194

M = gauge read monthly, in each case a second gauge.

There was one "partial drought" in the year, lasting for 33 days (Jan. 17 to Feb. 18) at 30 stations, with an average rainfall of 0·008 in. per day; for 34 days (Jan. 17 to Feb. 19) at 20 of these stations, with the same average daily fall; and for 37 days (Jan. 17 to Feb. 22) at three of these stations, with an average daily fall of 0·009 in. There was no "absolute drought."

The maximum falls of rain in any one day in each month, and the stations recording them, were: Jan. 16, Odsey, 0·70 in.; Feb. 26, New Barnet, 0·54 in.; March 15, Aldenham, 0·78 in.; April 9, Aldenham, 0·58 in.; May 30, Gilston Park, 1·58 in.; June 6, Hatfield St. Mary's, 1·52 in.; July 9, Summerhill, Barnet, 2·47 in.; August 27, Weston Park, 2·09 ins.; Sept. 25, The Chilterns, Hitchin, 1·01 in.; Oct. 29, Pendley Manor and Broxbourne, 0·65 in.; Nov. 1, Bone Hill, St. Albans, and Nov. 10, Pendley Manor, 0·65 in.; Dec. 7, Therfield, 0·38 in.

The day in each month on which a heavy fall of rain was most general over the county was: Jan. 16, Feb. 26, March 15, April 9, May 30, June 5, July 9, August 28, Sept. 25, Oct. 29, Nov. 26, Dec. 7; and in the year Jan. 16.

The rainfall reached at least one inch in 24 hours ending 9 a.m. on eight occasions during the year: once in May, twice in June, twice in July, twice in August, and once in September. On two of these occasions it exceeded two inches: July 9 and August 27. There are in the aggregate 50 records of at least an inch, and four of at least two inches.

The total yearly fall ranged from 19·31 inches at Hillside, Buntingford, to 28·29 inches at Pendley Manor, Tring; and the total monthly fall from 0·58 in. at Valency House, Eastbury, in February, to 4·47 ins. at Baldock, in August. The greatest fall in any day was 2·47 ins. at Summerhill, Barnet, on 9th July.

The rainfall of the Colne and Lea districts and of the Thames basin slightly exceeded the mean for the county, that of the Ivel district and of the Ouse basin was a little in defect, that of the Cam district was much below the county mean, and that of the Thame district was nearly as much above it.

TABLE XIII.—RAINFALL IN THE RIVER-DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	LEA.	OUSE.	THAMES.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	1·10	1·16	1·22	1·18	1·33	1·14	1·26
Feb.	1·11	·97	1·13	·87	1·02	1·00	·97
March	2·12	2·61	3·36	3·41	2·93	2·49	3·14
April	1·72	1·81	2·14	2·11	1·90	1·79	1·99
May	1·10	1·65	1·70	1·01	1·27	1·51	1·18
June	3·28	3·19	3·95	3·68	3·18	3·22	3·42
July	·96	1·23	1·36	1·28	1·84	1·16	1·60
August	3·03	3·51	3·07	2·79	3·21	3·39	3·03
Sept.	1·73	1·94	2·11	1·71	1·78	1·89	1·77
October	1·28	1·43	1·86	1·46	1·41	1·39	1·45
Nov.	2·13	2·53	3·31	3·12	2·77	2·43	2·93
Dec.	·78	·83	1·03	1·04	·91	·82	·97
Year	20·34	22·86	26·24	23·66	23·55	22·23	23·71
Diff. from 1880–99	—2·47	—1·58	—2·03	—3·87	—1·20	—1·62	—2·47

The mean rainfall in each of the minor river-districts was: *Cam*: (1) Rhee, 20·23 ins. *Ivel*: (2) Upper Ivel, 22·25 ins.; (3) Hiz, 22·98 ins. *Thame*: (4) Upper Thame, 26·25 ins. *Colne*: (5) Chess, 23·81 ins.; (6) Bulbourne, 24·11 ins.; (7) Gade, 26·45 ins.; (8) Ver, 25·40 ins.; (9) Upper Colne, 23·20 ins.; (10) Lower Colne, 21·65 ins. *Brent*: (11) Upper Brent, 26·41 ins. *Lea*: (12) Mimram, 23·68 ins.; (13) Beane, 24·10 ins.; (14) Rib, 21·23 ins.; (15) Ash, 22·73 ins.; (16) Stort, 24·93 ins.; (17) Upper Lea, 22·58 ins.; (18) Lower Lea, 25·20 ins.

The rainfall in Hertfordshire continues to be in excess of that of the adjoining counties, and in 1905 did not only exceed their average but was greater than that of any one of them. In previous reports the mean rainfall at certain selected stations only has been given for comparison. For 1905 it has been computed from all the stations in 'British Rainfall.' The result is as follows:—Cambridgeshire (50 stations), 19·59 ins.; Bedfordshire (23 stations), 20·47 ins.; Buckinghamshire (32 stations), 22·06 ins.; Middlesex, excluding London (49 stations), 22·26 ins.; and Essex (88 stations), 19·52 ins. The mean rainfall at all the stations (242) is 20·68 ins. Hertfordshire, with a mean rainfall (at 51 stations) of 23·49 ins., shows an excess over the average rainfall in the adjoining counties of nearly 3 inches in amount, and of 16 per cent. in proportion.

Two meteorological events in the year call for special notice, a hurricane at St. Albans, and elsewhere, but very locally, in the South of England, on Wednesday the 15th of March, and the thunderstorms which raged all over the county, and in fact extended all over the kingdom, on Sunday the 9th of July.

The wind was unusually high during the night of the 14th–15th March, and in the morning there were occasional thunderstorms. At about 1.45 p.m., after a loud peal of thunder, and when hail was falling, the gale increased to the force of a hurricane and did much damage in various parts of St. Albans, stripping slates and tiles off roofs, blowing down walls, ripping up fences, lifting up and carrying away carts, and demolishing a large temporary cartshed, its heavy timbers being hurled against the rear of some cottages, the windows and window-frames of which they drove in. For a full account of the damage done, reference should be made to the 'Herts Advertiser' of the 18th of March.

Taking, in the usual order, the localities in our county where damage was done by the thunderstorm, or series of thunderstorms, on the 9th of July, they are as follows:—

In the north of the county, at Hitchin, where the storm came on in the afternoon, a stone cross on St. Saviour's church was thrown on to the roof of the vestry, damaging it, a horse and a cow were killed, and the wheat crop was badly beaten down.

At Kensworth several trees were struck by the lightning. At Hemel Hempstead a bullock in Gadebridge Park was killed and a tree was struck. At St. Albans and Harpenden the storm appears to have been at its height between 12.30 and 1 p.m., and severe up to 2, continuing until between 5 and 6. At Watford it began at 12 noon, was at its height by 12.15, ceased for a time about 1, soon recommenced, and finally ceased about 5. Two houses in Callow Land were struck and damaged, and two larch-trees near each other at Russells. One of these is depicted on Plate I. It will be seen that a narrow strip of bark has been removed from nearly the top of the tree to the bottom. It was cut out as cleanly as if it had been done with a broad chisel.

I did not hear of it for some months afterwards, and had no opportunity of taking the photograph in a favourable light until the following spring, when the whiteness of the surface of the wood exposed under the bark had toned down. Mr. Lewis Evans, on whose estate the tree stands, informs me that he saw it struck at about 12.30, when sheltering in a greenhouse near it. The Chapel at St. Margaret's School, Bushey, was set on fire; after some damage had been done the fire was extinguished by the Bushey Fire Brigade. Many trees were struck in the neighbourhood of Elstree, from Hillfield Park to Shenley and Aldenham, and one, a willow, on the island in the Reservoir.

In the east of the county the whole of the district between Bishop's Stortford and Waltham Cross suffered severely, trees and houses being struck and much damage being done to the wheat and oat crops. A pig, a few cows, and some sheep were killed. At Bengeo an oak was split from the inside and the bark entirely stripped from the trunk. Roads were converted into rivers.

Notes on the Months.

January.—The weather was mild, with a dry atmosphere, a bright sky, and a small rainfall, but of frequent occurrence. The excess in the temperature was chiefly due to the warmth of the days, the mean daily range being considerable. The minimum temperature was below 32° on rather more than half the nights in the month, and at St. Albans on the 16th the temperature was below 22° at 9 a.m. That was the wettest day at all stations, and at 33 the rainfall was at least half an inch. A little snow fell on the 1st, 2nd, and 16th. The total rainfall (including snow) was a little more than half the average.

February.—The weather was very mild, with a dry atmosphere, a bright sky, and a small rainfall, but of frequent occurrence. Both days and nights were warm, the nights especially so for the month, the mean daily range of temperature being small. On but few nights did the minimum sink below 32°. The 20th was the wettest day at 5 stations, the 26th at 46, at 4 of which, in the Lower Lea district, the rainfall reached half an inch. Snow fell on the 12th, 21st, 23rd, and 26th to 28th. The total rainfall (including snow) was a little more than half the average.

March.—The weather was again mild, but the air was rather moist for the month, the sky cloudy, and the rainfall heavy and of very frequent occurrence. The excess of temperature was nearly twice as much due to the warmth of the nights as to that of the days, the mean daily range being small. The minimum was below 32° on three of the first four days in the month only. A little snow fell on the 1st, with rain, and up to the 18th or 19th rain fell every day but one or two. The rainfall reached at least half an inch on three days, on the 10th at 18 stations, on the 13th at 8, and on the 15th, with thunderstorms and hail, at 21. The total fall was nearly double the average.

APRIL.—Of average temperature, with a rather moist atmosphere, a very cloudy sky, and a little more than the average rainfall on a large number of days. The nights were much warmer than usual and the days much colder, giving a very small mean daily range of temperature. The minimum was below 32° on four days in the early part of the month. The 9th was the wettest day at 47 stations, at 6 of which, Aldenham House and all the five stations in the Lower Lea district, it exceeded half an inch. The 10th was the wettest day at 4 stations. The total rainfall was about a quarter of an inch above the average.

MAY.—Of average temperature, with a very dry atmosphere, an exceedingly bright sky, and a very small rainfall on very few days. The days were a little warmer than usual and the nights a little colder, the mean daily range of temperature slightly exceeding the average. The 2nd was the wettest day at 10 stations, and the 30th at 41. Between these dates scarcely any rain fell, the average for all stations for the 26 days being about 0·15 in. On the 30th the rainfall reached at least half an inch at 33 stations, three-quarters of an inch at 23 of these, and an inch at 14: Fairhill, Berkhamsted, 1·00 in.; Fanhams Hall, Ware, 1·02 in.; High Down, Hitchin, 1·06 in.; Apsley Mills, 1·10 in.; Kensworth, 1·17 in.; Feilde's Weir, Hoddesdon, 1·19 in.; Much Hadham, 1·25 in.; New Barnet Gas Works, 1·29 in.; Broxbourne, 1·34 in.; The Chilterns, Hitchin, 1·36 in.; Pendley Manor, Tring, 1·45 in.; The Maples, Hitchin, 1·55 in.; Wratten, Hitchin, 1·57 in.; and Gilston Park, 1·58 in. This fall was due to a thunderstorm, and most of the rain came down in a very short time. At Broxbourne the whole fell in three hours. At Berkhamsted 0·20 in. fell in ten minutes. The total rainfall was a little above half the average.

JUNE.—Of average temperature, with a rather moist atmosphere, a cloudy sky, and a heavy rainfall on rather more than the usual number of days. The nights were much warmer than usual and the days much colder, the mean daily range of temperature being very small. On the 5th the rainfall reached at least half an inch at 46 stations and three-quarters of an inch at 6 of these; on the 6th at least half an inch at 27 stations and three-quarters of an inch at 8 of these; on the 10th at least half an inch at 3 stations, and on the 15th at 10 stations, three-quarters of an inch at 4 of these, and 1·02 in. at Eastbury, Watford. On the 30th it reached at least half an inch at 28 stations, three-quarters of an inch at 3 of these, and 1·02 in. at Broxbourne. The total fall was 60 per cent. above the average. There were thunderstorms on the 15th, 16th, and 27th.

JULY.—The weather was very warm, with a very dry atmosphere, a very bright sky, and a small rainfall on very few days. Both days and nights were warm, the mean daily range of temperature being above the average. An account has already been given of the thunderstorms on the 9th. That was the

wettest day at 43 stations; and the 27th, when there was also a thunderstorm, was the wettest at 7. On the 9th the rainfall reached at least half an inch at 44 stations, three-quarters of an inch at 20 of these, and an inch at 12: Feilde's Weir, Hoddesdon, 1·10 in.; Gilston Park, 1·20 in.; Broxbourne, 1·38 in.; Stanstead Abbotts, 1·39 in.; Holwell House, Hatfield, 1·41 in.; Fanhams Hall, Ware, 1·60 in.; Hatfield St. Mary's, 1·80 in.; Aldenham House, Elstree, 1·86 in.; St. Just, Northaw, 1·97 in.; Bayfordbury, Hertford, 2·03 ins.; New Barnet Gas Works, 2·38 ins.; and Summerhill, Barnet, 2·47 ins. At Berkhamsted, about noon, 0·15 in. fell in 5 minutes, and after 4, 0·14 in. fell in the same time. On the 27th, in another thunderstorm, the rainfall reached at least half an inch at 9 stations, at least three-quarters of an inch at 2 of these, and at Gorhambury, St. Albans, 1·18 in. At Kensworth 0·28 in. fell in 40 minutes, and at Berkhamsted 0·10 in. in 4 minutes. Notwithstanding these heavy falls the total was about 40 per cent. below the average.

AUGUST.—A rather cold month, of nearly average humidity, with a cloudy sky and a heavy rainfall on a large number of days. The day temperature only was below the average, the mean daily range being less than usual. There were thunderstorms on the 5th, 27th, and 28th, with much rain, especially heavy on the 27th and 28th. On the 27th farm buildings at Weston and at The Bury, near Hitchin, were struck by the lightning, set on fire, and destroyed. This was the wettest day at 3 stations, and the 28th was the wettest at 48. The rainfall was at least half an inch at 2 stations on the 4th and at 3 on the 5th. On the 27th it was at least half an inch at 12 stations, three-quarters of an inch at 8 of these, and an inch at 4: Red House, Ware, 1·07 in.; Feilde's Weir, Hoddesdon, 1·13 in.; Baldock, 1·91 in.; and Weston Park, 2·09 ins. On the 28th it was at least half an inch at all stations, reaching three-quarters of an inch at 44, and an inch at 19: Fanhams Hall, Ware, 1·02 in.; Preston, 1·06 in.; Weston Park, 1·07 in.; Much Hadham, 1·08 in.; Apsley Mills, 1·09 in.; Rosebank, Berkhamsted, 1·10 in.; Rose Cottage, Berkhamsted, 1·10 in.; Hill End, St. Albans, 1·10 in.; Broxbourne, 1·10 in.; Gilston Park, 1·13 in.; County Museum, St. Albans, 1·14 in.; Bone Hill, St. Albans, 1·15 in.; Knebworth, 1·17 in.; Gorhambury, St. Albans, 1·20 in.; New Barnet Gas Works, 1·44 in.; Kensworth, 1·48 in.; Rothamsted, 1·56 in.; Summerhill, Barnet, 1·56 in.; and Pendley Manor, Tring, 1·58 in. At Berkhamsted, at 2 p.m., 0·08 in. fell in 5 minutes. The total rainfall was 25 per cent. above the average.

SEPTEMBER.—Rather cold, with a rather moist atmosphere, a cloudy sky, and a rather small rainfall of average frequency. The nights were a little warmer than usual and the days were much colder, the mean daily range of temperature being considerably less than usual. The only very wet days were the 9th and the 25th, the former being the wettest day in the month at 11 stations, and the latter at 40. At least half an inch of

rain fell at 2 stations on the 7th, at 10 on the 9th, and at 38 on the 25th, on which day there was at least three-quarters of an inch at 11 of these stations, and 1·01 in. at The Chilterns, Hitchin. The total fall was 25 per cent. below the average.

OCTOBER.—A very cold month, with a rather dry atmosphere, a sky of average brightness, and a very small rainfall of average frequency. Both days and nights were cold, the mean daily range of temperature being about the average. The minimum was below 32° on 6 days near the end of the month. The 28th was the wettest day at 5 stations, the 29th at 38, and the 30th at 10; on the 28th only did the fall reach half an inch, and that only at 9 stations. On the 4th, at Berkhamsted, 0·09 in. fell in 5 minutes. The total rainfall was less than half the average.

NOVEMBER.—Very cold, with a humid atmosphere, a cloudy sky, and a rather heavy rainfall on a large number of days. Both days and nights were cold, the mean daily range of temperature being about the average. The minimum was below 32° on twelve nights, and at St. Albans below 32° at 9 a.m. on the 18th. A few flakes of snow with a little hail fell on the 15th, and on this day the Aurora borealis was seen at Watford from about 9 to 9.30 p.m. The wettest days in the month were the 1st, 10th, and 26th, each being the wettest at about the same number of stations, and at several stations the same amount of rain fell on two of them, at one station the same on all the three days. The fall was at least half an inch at 10 stations on the 1st, at 10 on the 10th, and at 8 on the 26th. The total was 12 per cent. above the average.

DECEMBER.—Rather mild, with a humid atmosphere, a very cloudy sky, and a very small rainfall, rather less frequent than usual. The nights were much warmer than usual and the days slightly so, the mean daily range of temperature being small. The minimum was below 32° on eight nights, and at St. Albans on the 31st the maximum did not reach 32°, and the 9 a.m. temperature was only 29·7°. This was the coldest day in the year. The 5th was the wettest day at 2 stations, the 7th at 45, the 27th at 2, and the 29th at 2. The rainfall did not reach half an inch on any one day, and the total was less than half the average. Notwithstanding the very small rainfall, less than in any December for fifteen years, the weather was gloomy throughout the month. Christmas Day was the brightest, in fact the only really bright day in the month.

VIII.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1905.

By William Bickerton.

Read at St. Albans, 6th March, 1906.

At the end of the year 1904 the register of Hertfordshire birds contained the names of 223 recorded species. During 1905 I have heard of only one species not previously recorded for the county, viz. Leach's Fork-tailed Petrel (*Oceanodroma leucorrhoa*). This has been obtained in the Watford district, and I am pleased to say that I have myself had some small share in its identification and addition to our list.

In the 'Watford Observer' of Saturday, December 2nd, appeared a statement to the effect that a Stormy Petrel had been found dead during the week in Cassiobury Park, and that it was supposed the bird had been driven inland by the recent storm. Thinking that the matter was well worth investigation —and especially so as we have only two records for Hertfordshire even of the stormy petrel (*Procellaria pelagica*)—I wrote to the Editor and asked him to kindly give me what further information he could about the occurrence. In reply, he referred me to Mr. J. Goodall, of Watford, who had found the bird, and to Mr. Goodall in turn I wrote for particulars. Fortunately, the skin, though somewhat badly damaged, had not been destroyed, and Mr. Goodall passed it on to my keeping. On taking it to the South Kensington Museum, and comparing it with the specimens there, I found that it was not the ordinary stormy petrel (*Procellaria pelagica*), but a kindred member of the family which had never before been recorded for Hertfordshire, viz. Leach's fork-tailed petrel (*Oceanodroma leucorrhoa*). In due course I had the bird "set up," and so am able to exhibit it to you to-night. It differs from *Procellaria pelagica* especially in its larger size and its deeply-forked tail.

Of all sea-birds, the members of the petrel family are certainly the most sea-loving, spending by far the greater portion of their lives on the ocean-waters far from land. Of them, Mr. Charles Dixon writes in his 'British Sea Birds': "They are the birds of the wide ocean, even showing small partiality for narrow seas, and chiefly frequenting for breeding purposes only such spots as face the widest expanses of water. They are the most marine of birds, yet they form one of the least apparent features in the bird-life of the sea, and more especially when that bird-life is studied from the coast. Their crepuscular or nocturnal habits during their short visits to the land to breed, their sombre hues, their low flight, just above the waves, all combine in rendering these birds exceptionally difficult of observation." The characters which distinguish them as a group are their tubular nostrils,

hooked beak, webbed feet, and long wings—all of which are readily seen in our specimen now before you.

It may be mentioned, in passing, that the ordinary stormy petrel (*Procellaria pelagica*) is the smallest of our British web-footed birds, and is the bird known to sailors as "Mother Carey's Chicken."

Leach's petrel was first discovered as a British bird on the lonely group of rocks known as St. Kilda, away out in the Atlantic Ocean beyond the Outer Hebrides of Scotland. This was in 1818. In 1847 it was found breeding at St. Kilda, and subsequently on North Rona and several other islands of the Outer Hebrides. In 1886 its egg was obtained by Mr. R. J. Ussher from one of the Blasquets, off the coast of Kerry, in Ireland—the most westerly land, with the exception of Iceland, included in the continent of Europe. St. Kilda, however, continues to be its most famous breeding-place in our area, or, indeed, in all Europe. Of this species Mr. Dixon says: "During the non-breeding season it wanders vast distances from land, sleeping and resting on the sea when tired, following ships for miles, fluttering along close to the ocean, now down into the trough of the wave, anon skimming over the crest to half-fly, half-run, with patting feet, down the smooth surface of the next. Except during the breeding season, this petrel is not very gregarious; it may often be seen in parties of perhaps half-a-dozen, scattered over a considerable surface of water. The exact nature of the food of this species is apparently unknown. It is said, in a vague and general way, to feed on crustaceans and small molluscs, and the scraps of refuse cast from passing vessels, but birds which I have dissected contained similar substances to those found in the fulmar—a nearly clear oil, mingled with the jaws of cuttlefish and scraps of sorrel. The fork-tailed petrel resorts to its breeding-stations to nest in June. Although gregarious during this period, its colonies are never so large as those of the fulmar. Most probably the bird pairs for life, and returns season by season to certain spots to rear its young." And to quote Mr. Dixon again: "This petrel is not seen abroad much at its breeding-places during daylight; all day long the little birds skulk in their burrows, but with the approach of night they begin to sally forth from their retreats and nests, and their fluttering forms may be seen flitting to and fro in the deepening gloom, backwards and forwards, to and from the sea. The fork-tailed petrel is not a very noisy bird; those that I dragged from their nests uttered a few squeaking notes; but at night the species becomes more garrulous."

So entirely pelagic a bird, though a British breeding-bird, is never seen inland except against its will. It does not come, like so many other of our rarer visitors, by the chances—or shall I say the mischances—of its migratory journeys. During westerly and south-westerly gales of exceptional violence it is blown quite out of its reckoning—sometimes even right across

Ireland and England to the Eastern counties. On 26th and 27th November, 1905, such a gale was in evidence, and to this occurrence doubtless we owe the presence of our Watford specimen.

It is perhaps worthy of remark that a note in 'Knowledge' for January, 1906, recorded the fact that another bird of the same species had been obtained during the last week in November, 1905, at Caversham, in Berkshire, having probably been driven inland by the late strong westerly winds.

In concluding my notice of this interesting addition to our fauna, I should like to express my thanks to the Editor of the 'Watford Observer' and also to Mr. J. Goodall for the assistance they so readily gave me in connection with the matter.

This being the only addition to our list, I now pass, as usual, to my general notes, taking the birds in the order of the recognized list.

Commencing with the thrush family, I noticed that in the Watford district these birds were unusually silent during January (1905). There was very little song, indeed, until almost the end of that month and the beginning of February, and this has been in marked contrast to the experience of previous years. Coming to the end of the year, I heard a thrush (*Turdus musicus*) in full song at Munden on November 4th—a wet, dripping, autumnal day. Quite early in December a fair number of thrushes were singing, and the volume of song increased considerably right on through that month and into January of the present year. Since writing the above I have heard from Mr. M. Vaughan, of Haileybury, who states: "The spring notes were late; I heard the first thrush on February 2nd" (i.e. 1905). It may be remembered that in my report for 1904 I referred to the fact that the nest of a blackbird near Hamper Mill had been found "adorned" with the strips of paper scattered on the road by boys when having a paper-chase. It is a little singular that a nest of the song-thrush has this year been found (and reported to us by Mr. J. Langford Lewis) with similar paper-cuttings woven into its structure. This also was near Hamper Mill, and Mr. Lewis has kindly sent me a photograph of the nest, which, by the way, was taken for, and reproduced in, the 'Daily Mirror.'

There were a fair number of Redwings (*Turdus iliacus*) in the Watford district during the early months of the year, but I have not seen one of this species so far during the winter of 1905–6. Fieldfares (*T. pilaris*) were more plentiful both at the beginning and end of 1905, and were, I think, earlier than usual in arriving. I saw and heard the first one on October 29th, between Hamper Mill and Northwood. Mr. E. P. Thompson reports that at Elstree fieldfares and redwings have been scarcer than usual, the latter very much so. On the other hand, Mr. G. E. Bullen reports that redwings have been more plentiful and fieldfares scarcer in the St. Albans district.

Wheatear (*Saxicola œnanthe*).—Mr. Vaughan, of Haileybury, reports the wheatear as passing on March 28th, which, he states, is an average date, and Mr. A. H. Foster, of Hitchin, reports a small company of six on April 4th. Mr. A. W. Dickinson, St. Albans, reports one on May 3rd. I saw one on Croxley Common Moor on May 7th, and this is the first and the only one I have ever seen in Hertfordshire. As the wheatear is one of the first of the summer migrants to reach England, usually arriving during the latter half of March, I hardly think the two last-named specimens here recorded were "on passage." It is not easy to account for their presence unless one concludes that they were old unpaired birds. I may add that I have only heard of one other record of this bird for our county during the five years I have been acting as recorder.

Of the smaller Warblers, Mr. Vaughan reports that on March 25th he saw and heard five Chiffchaffs (*Phylloscopus rufus*) in different places, and that he heard birds of the species constantly after that date. The first Willow-Wren (*P. trochilus*) he heard on April 4th, which is rather early. The Wood-Wren (*P. sibilatrix*) does not appear at all in the records of the year.

Stonechat (*Pratincola rubicola*).—I have for the first time found the nest and young of this bird in the Watford district—within $2\frac{1}{2}$ miles, in fact, of the town.

Bearded Titmouse (*Panurus biarmicus*).—I think most of you will be astonished to hear that a specimen of this extremely local, rare, and interesting bird has been seen on one of the quieter waters in the western part of the county. The exact locality I am, for obvious reasons, asked not to indicate. The gentleman who saw the bird is perfectly familiar with it in its native haunts in the Norfolk Broads (Hickling Broad especially), the one district remaining in the British Islands where the "reed-pheasant," as the Norfolk marshmen call it, is really at home. There cannot, therefore, be the least doubt as to the authenticity of the record, and the pleasure of reporting it is doubled by one's being able to add that the bird was not destroyed, as so many rarities are when they get beyond the limits of their normal range. I am inclined to class this as perhaps the most extraordinary incident in what I think has been a somewhat unusual year from an ornithological point of view in Hertfordshire, and especially so as we have only three previous records of the appearance of the bird in the county—the last one being in July, 1888. The specimen now reported was seen during the last week of January (1905), and the observer informs me that he only saw it on the one occasion. As perhaps most of you know, the bearded tit has now for many years past been practically confined to the district of the Norfolk Broads, and even in that district fears of its absolute extermination as a British breeding species have, owing mainly to the greed of collectors both of eggs and skins, been entertained. Happily, owing to more rigid protection, these fears have not

been realized, and the bird appears for the time being to be not only in no danger of extinction, but actually increasing in numbers. While, as stated, it is for the most part sedentary in the Norfolk Broads during summer, it appears also to be somewhat given to wandering in the winter months. About the time that our specimen was seen in Hertfordshire, I noticed in one of the natural history papers that a small party of three or four had been seen (and shot) in the Oakham district in Rutland. It seemed, therefore, that these as well as our Hertfordshire specimen were birds which had either migrated from the Continent or wandered from the Broads, and in order to clear up this point, if possible, I wrote to the Rev. M. C. H. Bird, M.A., M.B.O.U., of Stalham, who probably knows more from actual all-round-the-year observation of the bearded tit than any other person in England. He sent me the following interesting particulars in reply:—"There is no inherent impossibility in your having had a reed-pheasant in Hertfordshire, the Languard Fort migrant proving the possibility of this species getting so far as from here to you—unless, of course, the Languard specimen was an escape. Years ago I used to look upon these birds as practically stationary throughout the year, but they have been seen in North Norfolk in autumn, and within later years I have been surprised to meet with them in unexpected spots in Broadland during the winter months; but I do not think that they roam over other parts of this country systematically. There certainly is no immigration from the Continent to us at any season. Our reed-grounds are decreasing, whilst bearded tits are rather on the increase, and so I should fancy that the stray specimens which have cropped up lately in other parts of the country were wanderers from Norfolk. In winter they seem more restless and take longer flights than at other seasons, and only last Tuesday (6th February, 1906) I was watching some at Catfield mounting high in the air and travelling two or three hundred yards ere dropping into the reeds again, passing over similar vegetation all the time that they were on the wing. In spring, summer, and early autumn they are much more crepuscular, and do not show themselves much above the reeds, rushes, and sedges."

Tree-Creeper (*Certhia familiaris*).—In 1902 I reported on the then increasing scarcity of this attractive little bird. I regret that I cannot now, after three years' further observation, report any increase in its numbers so far as the Watford district is concerned. In fact, it seems to get more and more scarce each year. I have seen only three during the year, two of which it is perhaps worth stating were nesting in a tree growing at the side of a well-used high road near Watford. The old birds were busy carrying in food to the youngsters, so that the traffic had not interrupted their domestic arrangements. Speaking of this little bird nesting by the roadside reminds me, by-the-bye, of one of the most amusing incidents which has ever come under my notice

during my bird-watching experiences, and although it happened so long ago as 1900 I think it is well worth recording. About the end of May in that year I was returning from Bricket Wood to Watford along the high road *viâ* Garston. Almost exactly opposite the little Post Office in the last-named village, a footpath branches off from the high road across the fields to Bricket Wood, and not many yards from the little gate which gives access to this footpath a large oak-tree grows in the roadside hedge. This tree bears the usual minatory notice-board intimating that "trespassers will be prosecuted." While stopping to rest at the gate I saw a little bird with something in its beak glance down from the foliage above, alight on the top of the notice-board, look round for an instant (not at the inscription, however), and then disappear into the narrow space between the board and the trunk of the tree. In a moment he was out again and up among the branches. A second bird came, alighted on the board, disappeared behind it, and likewise emerged again a moment later to fly aloft. For the moment I could scarcely believe my eyes, but further watching showed that the performance was again and again repeated, now by the one and now by the other of the two birds. I settled down to watch the proceedings, and, timing them with my watch, I found that the two birds paid no less than 42 visits "behind the scenes" in 47 minutes. They were a pair of tree-creepers, and they had actually had the audacity to build their nest behind that notice-board! In spite of their cramped position, and the awe-inspiring threat behind which they were living, the young birds seemed thriving and blessed with good appetites, which their parents were doing their best to satisfy. As to the said parents, I scarcely knew which to marvel at most—their intelligent knowledge of letters and the astute purpose to which they had turned it, or their open contempt for the law of the woodland.

Yellow Wagtail (*Motacilla raii*).—This bird has been extremely plentiful in all parts of the Colne Valley during the past summer. I do not remember seeing such relatively large numbers in any former year. It seemed to be nesting in the water-meadows all the way along the valley. After prolonged search, I succeeded in finding a couple of nests on the same day and in the same enclosure. Each contained five eggs.

Swallow (*Hirundo rustica*).—The following letter from Lady Frances Bushby appeared in the 'Hertfordshire Mercury' of 11th November, 1905:—"In a letter in your issue of the 4th inst., Mr. Waller, of Villiers Street, Hertford, mentions having seen swallows on the wing on November 1st, and he asks for the experience of other observers as to the late appearance of these birds in Hertfordshire. Looking back to some notes made many years ago at Wormley Bury, near Broxbourne, I find that I saw several swallows there on 14th November, 1880, after which day they were not seen again. In the same place, on 10th November, 1883, during a bright sunny interval following

on long-continued dull weather, I noticed two of these birds flying to and fro on the southern side of the house. None had been seen for many weeks, and it was supposed that all had long since left us for a warmer climate. Although the bright sun had called into activity a fair number of small insects, it seemed strange that these two birds should get their living with so much apparent ease while coursing over a comparatively limited space. From the time of their first appearance they were seen each day, sweeping past the windows in pursuit of food, remaining on the wing so late as a quarter or twenty minutes past four, when the air was keen and day growing dull. On the night of November 11th the garden thermometer registered four degrees of frost, and on the next morning the birds began their flight while the rime lay white upon the lawn. I could not tell their resting-place; the twilight always closed upon them as they sat on the stone coping at the top of the house. They were seen for the last time on November 13th, the garden thermometer having registered six degrees of frost on the previous night." In the issue of the same paper for the week following appeared letters stating that swallows had been seen in Hertford (Mr. W. S. Harrison) on 11th November, 1905, and at Broxbourne (Mr. A. E. Price) so late as 15th November, 1905.

House-Martin (*Chelidon urbica*).—Mr. R. T. Andrews, of Hertford, sends me the following note:—"In November I received from a gentleman at Cole Green a martin's nest in a small tin colander. In the August thunderstorm he stated that it was noticed that the nest was in danger of falling, and as it had young in it, he, in the absence of the parent birds, took it down, placed it in the colander (about 6 in. in diameter), and covered it partly with a tin plate or cover, and fixed it up in just the same place where the nest was. The old birds took to it, reared their progeny, fixed the nest more securely in the tin, and brought off another brood besides." Mr. D. Hill (Watford) also sends a note supplementary to the one he forwarded last year: "With regard to house-martins, I have several nests on the south and west side of my house, but the nest I wrote to you about last year on the north-east side has not been occupied this year, though when the birds first came over a pair visited it, and I believe almost commenced to patch it up, but eventually moved to the warmer side of the house." Comparing the dates given in various localities as to the final departure of the swallows and martins, it seems that these birds are generally seen later on the eastern side of the county than on the western. From Watford, I have no date later than November 1st (Mr. D. Hill); at St. Albans the latest date is October 20th (Mr. H. Lewis and Mr. A. W. Dickinson); while at Hertford the latest date (see *ante*) is November 11th, and at Broxbourne November 15th.

Sand-Martin (*Cotile riparia*).—I happened to pay a visit to the Tring Reservoirs on October 28th, and at the Wilstone Reservoir I noticed some of the swallow tribe circling about, and

others flying low over the surface of the water. Glancing up the side of the lake, I saw, under the shelter of a large embankment, a little dark bird crouching on the ground just at its base, and, approaching nearer, I saw that it was a house-martin. It allowed me to get within six yards before taking flight. It seemed very loth to go at all, yet it flew fairly well when it once got away. Soon after I had passed, it was back again near the same spot, and on my returning, it this time allowed me to go right past it without taking flight. It looked very feeble, benumbed by the cold in fact, and I had no doubt it was a young bird. There were one or two others about. More strange still, I next saw a couple of sand-martins crouching in the same place, and their brown plumage was very distinctly seen. I could scarcely believe my eyes at first, for I thought all the sand-martins had migrated long ago. On looking round, I identified three others of the same species, and I think that some of the other hirundines flying about there—a dozen to fifteen in all—were also of the same kind. They took fairly long flights across the water, but they all in turn seemed very glad to get back for prolonged periods of rest to the shelter of the high bank.

On returning a second time along the same route, I also saw and identified two swallows, so that here were all three kinds of our hirundines living through the spell of the unusually hard weather we were then experiencing for the end of October. The house-martins and the sand-martins were, I fear, too enfeebled to take the long migration flight, but the swallows looked all right, and capable of anything in the way of flight. I should not have quoted this incident at such length had it not been for the quite unusual presence of the sand-martins so late in the year. Had I not been perfectly well acquainted with all three species, and had I not had them all there before me at the same time, I should, as stated, scarcely have believed my eyes so far as the sand-martins are concerned, for these are the first of the family to come in spring, and also the first to depart in autumn, their return journey being usually taken in August and September.

Goldfinch (*Carduelis elegans*).—This bird, it is pleasant to state, is again reported to be on the increase. Mr. E. P. Thompson (Elstree) reports a flock of seven early in March; Mr. H. Lewis (St. Albans) reports an increase in his district; and Mr. E. Hartert reports similarly from Tring. I have seen more of them than in any previous autumn, including one bird (with chaffinches) in Cassiobury Park on October 22nd, a fine gathering of fifteen near Wilstone Reservoir on October 28th, four at Batchworth Heath on October 29th, and three at Dors Common on November 5th. I have also heard of a number haunting Croxley Moor, and that practically all of them were taken by birdcatchers, who, it seems, in spite of County Council Orders and Acts of Parliament, still ply their nefarious trade.

Brambling (*Fringilla montifringilla*).—It is three years since I saw or heard of any bramblings in the county. This winter

(1905–6) there have been large flocks of them in the Watford district—on the outskirts of Cassiobury Park especially. They seemed rather early in arrival, too, for I first saw them at Sarratt on November 5th.

Siskin (*Chrysomitris spinus*) and Lesser Redpoll (*Linota rufescens*).—These have been present in the Watford district in about average numbers. One rarely sees them except in the alders and birches which fringe the streams.

Cirl Bunting (*Emberiza cirlus*).—Mr. E. Hartert reports that this bird was heard singing in the middle of June on the Chiltern Hills near Tring. This is the first record of it we have had for many years.

Magpie (*Pica rustica*).—During my seven years' residence in this district I have previously to this year seen only one magpie. I am glad, therefore, to report that on October 22nd I saw four in one place not far from Chandler's Cross, and on November 5th I saw two in the same spot, and also two others at Micklefield Green. I understand that on the Duke of Bedford's estate at Chenies these handsome (if destructive) birds are protected. Probably, therefore, Chenies acts as a sort of local "centre of dispersal" for them, and the presence of those I saw is thus probably accounted for. I fear, however, that not many of the birds which thus disperse themselves are allowed either to remain in their new quarters or to get back to their old ones.

Raven (*Corvus corax*).—Mr. E. P. Thompson (Elstree) reports that a pair of these all-too-rare birds were seen at the Reservoir on July 27th. This is another extremely interesting item for the year, as the last occurrence of the bird mentioned in our 'Transactions' was in December, 1894, at Tring Park. It is only in a few places in our mountainous districts or on our rock-bound coasts that this bird of ill-omen still holds his own and brings off his young. Mr. A. Crossman, in his list of Hertfordshire birds, remarks: "This bird was probably a fairly plentiful breeding-species in Hertfordshire in former times, but it has now vanished."

Nightjar (*Caprimulgus europæus*).—Mr. M. Vaughan reports that last year he noticed a nightjar hawking over the quadrangle at Haileybury. As this is enclosed by buildings its appearance is all the more remarkable.

Of the Woodpeckers, Mr. Vaughan reports that a Greater Spotted (*Dendrocopus major*) was seen flying over the Cottage Field, Haileybury, on May 14th; Mr. E. P. Thompson reports both Greater and Lesser (*D. minor*) Spotted from Elstree; while Mr. H. Lewis states: "My son, Mr. J. Lewis, noticed a lesser spotted woodpecker on April 12th near the back of a house in St. Peter's Street, St. Albans."

I have also a note of the appearance of several "French Woodpeckers" near Hertford.

Shoveler Duck (*Spatula clypeata*).—Mr. E. Hartert (Tring)

reports that a pair of these ducks were shot on the Reservoirs in December. Our last record was in 1901.

Wigeon (*Mareca penelope*).—During the hard weather in January, 1905, a duck of this species haunted the river (Gade) in Cassiobury Park for about a fortnight. It was by no means a shy bird, and was ultimately shot. It is perhaps worthy of remark that on one occasion while I was watching this bird (which, by-the-bye, fed quite freely in the daytime), both a kingfisher and a green woodpecker alighted within my field of observation, and I was able to watch and admire each of the three in turn. I do not think it is given to many men to have such a unique trio of birds under observation at one and the same time.

Pochard (*Fuligula ferina*).—Mr. J. R. Murray informs me that during September he shot three birds of this species at Elstree, and that he regards these as very rare visitors there. I saw a good number at Tring on October 29th, as also of the Tufted Duck (*Fuligula cristata*).

Quail (*Coturnix communis*).—I have heard of this bird from four districts during 1905, this being the first record we have since 1900. Mr. E. P. Thompson reports one at Elstree on April 25th, and Mr. R. T. Andrews reports one that had killed itself by dashing against the telegraph wires near Ware Park. The following note appeared in 'The Zoologist' for October (1905):—"Reappearance of the Quail (*Coturnix communis*).—While I was in Ireland in the middle of July my brother informed me that Quail had appeared in considerable numbers in his neighbourhood, near Enniscorthy, co. Wexford, this season. They had, in fact, been widespread, and had been noticed by most of the country people about there. It was, therefore, with great interest that I heard the liquid triple call of this bird in my own neighbourhood here on July 30th, directly after my return home. I heard several of them calling together, first in a field of ripe wheat, and afterwards in a large field of barley, at some little distance from the first locality. As these birds have not been observed here for many years, and have been considered almost extinct for the past twenty-five years in Ireland, their reappearance this season in some numbers is worthy of being recorded."—Allan Ellison, Watton-at-Stone, Herts. On the other hand, Mr. E. Hartert reports: "Quails are becoming rarer; in fact, we have not seen or heard one these last three or four years."

Corncrake (*Crex pratensis*).—This bird, for some mysterious reasons, seems to continue scarce, and is so reported from various districts in the county.

Stone Curlew, Norfolk Plover, or Thicknee (*Œdicnemus scolopax*).—A bird of this species was shot by Mr. Boys, of The Grange, St. Albans, at New Farm, St. Albans, during November, and is now in his possession. This is the first specimen of the bird I have heard of in Hertfordshire during my residence here, and I think it must be a good many years since its occurrence

was last noted in our 'Transactions.' This is the more curious because, even if it does not still linger on as a breeding-species in odd places in the north or north-east of the county, I feel convinced that it must pass through the county on migration both in spring and autumn. During the day, however, it is rather a quiet bird, becoming vocal only after dusk. Perhaps this is the reason why it is not more frequently reported.

Golden Plover (*Charadrius pluvialis*).—This bird is reported by Mr. A. W. Dickinson (St. Albans) to have been more plentiful during 1905. Mr. M. Vaughan (Haileybury) reports a solitary specimen on October 17th, but also states: "On 24th January, 1906, I saw a fine lot of quite 200 in number not a mile from here—the biggest lot I have seen for years." With regard to this and other members of the great and widely-dispersed Limicoline family, the same observer reports: "There are nothing like so many snipe, woodcock, and golden plover as there were 25 years ago. It is years since I saw a snipe near here."

With regard to the Common Snipe (*Gallinago celestis*), I know of one or two districts in the western part of the county which are every winter visited by this bird in fair numbers. And, strange to say, a pair of snipe have, during 1905, been found nesting in the Watford district—an incident which I think may also be classed as one of the extraordinary incidents of what, as I have before said, has been a somewhat unusual year from an ornithological point of view. The occurrence itself is all the more extraordinary when one considers the strange locality and surroundings chosen by the birds for their nesting-haunt. As I do not think there is the remotest chance of the birds ever repeating their visit to the situation in which they nested last year, I cannot do any harm in stating that this was on Croxley Common Moor—a small piece of rough common-land, marshy in places, between Watford and Rickmansworth. When it is considered that this bit of rough land is bounded on three sides by railways and on the fourth by the Grand Junction Canal, that it is common-land open and free for everyone to roam over, that there is a much-used footpath running across it, that the boys of the village search it pretty thoroughly in the springtime for any pheasants' or partridges' eggs that may be found on it (and for the finding of which they get rewarded), I think you will agree that it is about the last place in the world where one would expect to find the nest of so rare, so shy, so wary, and so inaccessible a bird as the common snipe. The nest was well hidden in the midst of a tuft of dry grass, and was only 50 paces from the railway and perhaps 80 paces from the footpath, and therefore on the least remote part of the common. It was first found by some of the boys, who chanced to flush the bird from the nest, which then contained four eggs. One of these was broken, but, thanks to the intervention of the keeper, the other three were restored to the nest, and the bird returned to them. I first saw the nest and three remaining eggs

on May 5th, and two days later I took a small photograph of them. On May 9th I found two boys with a dog standing over the nest, and, on looking at the eggs, I found that there were only two, and these were chipping. I could easily see the chicks moving at the tiny holes their beaks had made. I cleared the boys away, covered up nest and eggs as well as I could, and did the little I could do to protect and preserve them. Two days later, on revisiting the moor, I found the grass all torn up, nest pulled out, and ground and grass for some distance around all trodden over and trampled. As the young of the snipe can run as soon as they emerge from the egg, it is, of course, just barely possible that the mother had got away with the chicks, but I very much doubt if she was so fortunate. I fear her two remaining eggs, absolutely valueless as they must have been to anyone, had been wantonly destroyed. I have mentioned some of the circumstances which went to make the whole incident, from the human point of view, at all events, a most extraordinary one. And this is the more so when one considers that within two minutes' flight from where the nest was, there were numbers of situations in private and preserved grounds where the birds would have been absolutely quiet and free from disturbance—in all probability undiscovered; and where they might certainly have hatched-off their brood in safety. I cannot find anywhere in our 'Transactions' a record of the snipe having nested in Hertfordshire before. We are, therefore, now entitled to add it to the list of birds which have bred in the county, and for this addition to the list we are indebted to Lady Ebury, who kindly reported the incident to Mr. Hopkinson.

Dunlin (*Tringa alpina*).—I saw a solitary specimen of this bird at the Tring Reservoirs on October 28th.

Redshank (*Totanus calidris*).—Although this bird is said in Mr. Crossman's list to be an occasional visitor to Tring, there are only two definite records in that list of its having been obtained in the county—one in 1875 or 1876, and the other in 1891. I have now to report that two pairs of these birds, certainly rare so far as Hertfordshire is concerned, have been seen during the summer within a few miles of Watford, and that there is every reason to believe they have successfully nested there. During the last week in May I was spending a holiday among the gulls, terns, and other shore- and marsh-birds in the west of Cumberland, when a letter reached me from Watford stating that two pairs of birds unknown to the writer were haunting—and evidently nesting on—a piece of quiet, reserved, marshy ground within a few miles of Watford. I cannot mention the exact locality, because I am in hopes that the birds may return to the spot during 1906, and nest there again, and I do not want them to be disturbed. The writer of the letter asked me if I could help him to identify the birds, and on my return to Watford in early June I visited the locality indicated, and found that they were redshanks—birds of the same species,

and acting in precisely the same manner, as those I had been watching only the week before on some of the sea-marshes of Cumberland. I did not, however, see more than the one pair—my informant had seen two pairs. It was, of course, too late then to expect to find the eggs of so interesting a species, for the redshank is an early breeder—in fact, I was too late for them even up in the north. But, personally, I have not the least doubt that the birds had nested, and that in the rough, long, partially water-logged grass of the area where they haunted, they had their young ones. These I tried to find, but without success. Redshanks are extremely noisy during the breeding-season when they have either eggs or young, and so long as an intruder is on their breeding-grounds they will not cease to fly round and round calling loudly and continuously. The birds I saw well maintained the characteristics of their species in this respect. "Them cussed yelpers," the Norfolk marshmen call them, for they alarm all the wild inhabitants of the marshes as soon as an intruder comes in sight. I can only again say that this is another of the unusual incidents of the year, and that I, for one, certainly never expected to be able to add the redshank to the list of Hertfordshire breeding-birds. This, however, I can confidently do, and the more confidently as Mr. R. B. Lodge, of Enfield, reported to one of the natural history papers last year that both the redshank and the ringed plover (*Ægialitis hiaticola*) had been found breeding in North-East Middlesex. I may state that I enquired of Mr. E. Hartert, of Tring, as to whether the redshank had been known to breed at Tring, and he informed me that it had not. Considering that this bird has now been seen, and has nested, both in Herts and Middlesex, it looks as if, in common with some other species, it is extending its breeding-range to fresh districts in which it can find habitats suited to its needs. If two pairs nested successfully in Hertfordshire last year, there is no reason why half-a-dozen pairs should not do so this year. May one, therefore, venture to hope that landowners and their keepers will give the birds every protection which lies in their power? May one also appeal to the members of the Hertfordshire County Council who are interested in bird-life, and ask that they will take such action as will result in having the eggs of the redshank, as well as the bird itself, placed on the protected list as soon as possible?

Black-tailed Godwit (*Limosa belgica*).—Last year I was able to report that a bird of this species had been taken at Tring, and that this made the second instance of the bird having been seen in Hertfordshire. In the course of my remarks I further stated that this bird formerly nested in our eastern counties, especially in Yorkshire, Lincolnshire, Cambridge, and Norfolk, eggs being taken in the last-named county until the year 1847. I have now to report the following note from Mr. M. Vaughan (Haileybury): —"It may interest you to know that in all probability a pair of the above tried to nest only twenty years ago. They were seen

by a friend of mine, who knows the bird well in Holland. Professor Newton, I believe, thought there was something in it. The locality I am not to mention."

The eggs of the cuckoo have been reported as found in the nests of the following birds during the year:—Hedge-sparrow and pied wagtail. In one case, where a cuckoo's egg had been laid in a hedge-sparrow's nest, it was stated that, in addition to the young cuckoo, the nest contained the full complement of young hedge-sparrows. This, I take it, could only hold good for a short period immediately after the young had hatched out. If otherwise, I can only conclude that the young cuckoo referred to was of an unusually amiable and unselfish character.

The following birds are reported as having been more plentiful during 1905 :—Goldfinch, nightingale, corncrake, lapwing, golden plover, sparrow, greenfinch, chaffinch, kingfisher, red-backed shrike, wood-pigeon, greater and lesser spotted woodpeckers, swift, starling, blackbird, thrush, wryneck, hooded crow, and goldcrest; while those stated to have been scarcer are: "All the warbler tribe," yellow-hammer, owls, hawks (especially sparrow-hawk), greater whitethroat, nightingale, tree-creeper, wood-pigeon, snipe, woodcock, grasshopper-warbler, chiffchaff, swallow, house-martin, fieldfare, and redwing.

Of curious nesting-places the following have been reported:—(1) A thrush's nest built on the top of an old nest.—Miss Dickinson (St. Albans). (2) A jenny-wren's nest built in a piece of cork with stag's-horn fern growing on it, and hanging in a greenhouse. The nest was built of moss gathered from the orchid-pots; it was finished, but not utilised.—Miss Dickinson. (3) A robin nested in a small can under a garden-seat, but the rats took the young ones.—Mr. W. Graveson (Hertford). (4) A tit's nest in a hole in a door-post to which access is gained through a narrow slit, through which the birds can hardly squeeze themselves. The hole is now (February, 1906) full of bats, but ten days ago the tits were examining it, evidently with the idea of nesting.—Mr. W. Newall (Red Heath). Mr. H. Lewis (St. Albans) reports that a robin's nest containing five eggs was observed as early as 27th February, 1905, within the city. The same observer also records the following:—"I saw and heard a gentleman whistle young moorhens and also the cock-bird to him to feed them in the pond in his garden. They appeared quite tame, but a little shy of me. This was on the 9th of June. I believe the hen-bird was sitting on her second clutch of eggs."

This concludes what I venture to think is the most interesting of the reports which it has been my privilege to prepare for the Society. It is the most interesting, not by reason of any large number of new species added to the list for last year, but rather by reason of the unusually interesting character of several of our bird visitors that have perhaps on previous occasions been reported in the county. I refer especially to the visit of the

bearded tit and the ravens, and of the addition to the list of breeding-species of the common snipe and the redshank, inasmuch as each of these incidents in its way is indicative of new tendencies in the species referred to. It is, as I have before said, the possibility of meeting with new and unexpected incidents of this kind which gives to bird-watching so much of its pleasure and its charm.

As will be evident from the report, much valuable information can be gathered by those of us who have no particular expert knowledge of the science of ornithology, and who in fact may not at the moment fully appreciate the significance of any observations or reports which they may make thereon.

To all the local correspondents who have so kindly supplied me with notes, and given me information in connection with my enquiries, I desire to tender my very cordial thanks. Their work has been most valuable; in fact, so much so, that without it, it would be obviously impossible for me to have laid so much interesting material before the members of our Society.

The list of summer visitors, with dates of arrival or departure, is as follows :—

Species.	Locality.	Date.	Observer.
Wheatear	Haileybury	Mar. 28	M. Vaughan.
(*Saxicola œnanthe*)	Hitchin	April 4	A. H. Foster.
	St. Albans (N.Fm.)	May 5	Miss Dickinson.
	Croxley Moor	,, 7	W. Bickerton.
Redstart	Hitchin	April 14	A. H. Foster.
(*Ruticilla phœnicurus*)	Watford	May 6	W. Bickerton.
Nightingale	Elstree	April 6	E. P. Thompson.
(*Daulias luscinia*)	Hitchin	,, 12	A. H. Foster.
	Watford	,, 13	Mrs. Hopkinson.
	St. Albans	,, 13	A. Grey.
	Hitchin	,, 16	A. W. Dawson.
	Odsey	,, 16	H. G. Fordham.
	Broxbourne	,, 17	Rev. H. P. Waller.
	Berkhamsted	,, 21	Mrs. E. Mawley.
	Hatfield	,, 23	Miss E. Blackett.
	Sawbridgeworth	,, 23	H. S. Rivers.
Greater Whitethroat	Hitchin	,, 14	A. H. Foster.
(*Sylvia cinerea*)	Watford	,, 16	W. Bickerton.
Blackcap	Hitchin	,, 6	A. H. Foster.
(*Sylvia atricapilla*)	St. Albans	,, 15	A. H. Lewis.
Chiffchaff	,,	Mar. 19	Mrs. Turle.
(*Phylloscopus rufus*)	Bushey Heath	,, 23	P. J. Barraud.
	Haileybury	,, 25	M. Vaughan.
	Hitchin	April 5	A. H. Foster.
	Watford	,, 8	W. Bickerton.
	Elstree	,, 14	E. P. Thompson.
Willow-Wren	Watford	,, 2	W. Bickerton.
(*Phylloscopus trochilus*)	Haileybury	,, 4	M. Vaughan.
	Bushey Heath	,, 9	P. J. Barraud.
	St. Albans	,, 13	H. Lewis.
Sedge-Warbler	Watford	May 3	W. Bickerton.
(*Acrocephalus phragmitis*)			
Yellow Wagtail	St. Albans	April 27	A. Grey.
(*Motacilla rail*)	Watford	May 7	W. Bickerton.

Species.	Locality.	Date.	Observer.
Tree-Pipit	Watford	April 13	W. Bickerton.
(*Anthus trivialis*)	Hitchin	,, 13	A. H. Foster.
Spotted Flycatcher	Sawbridgeworth	May 22	H. S. Rivers.
(*Muscicapa grisola*)	Odsey	,, 25	H. G. Fordham.
	St. Albans (N.Fm.)	,, 26	Miss Dickinson.
	Berkhamsted	,, 27	Mrs. E. Mawley.
Swallow	Aldenham	April 6	Miss Selby.
(*Hirundo rustica*)	St. Albans	,, 6	H. Lewis.
	,, (New Farm)	,, 11	Miss Dickinson.
	Sawbridgeworth	,, 11	H. S. Rivers.
	Elstree	,, 12	E. P. Thompson.
	Hitchin	,, 12	A. H. Foster.
	Hatfield	,, 12	Miss E. Blackett.
	Harpenden	,, 14	J. J. Willis.
	Watford	,, 16	W. Bickerton.
	Broxbourne	,, 16	Rev. H. P. Waller.
(Last seen)	Berkhamsted	Oct. 14	Mrs. E. Mawley.
	Watford	,, 16	Mrs. Hopkinson.
	St. Albans (N.Fm.)	,, 18	Miss Dickinson.
	Odsey	,, 18	H. G. Fordham.
	St. Albans	,, 20	H. Lewis.
	Broxbourne	,, 29	Rev. H. P. Waller.
	Watford	Nov. 1	D. Hill.
House-Martin	Elstree	April 22	E. P. Thompson.
(*Chelidon urbica*)	Watford	May 2	W. Bickerton.
Sand-Martin	Hitchin	Mar. 30	A. H. Foster.
(*Cotile riparia*)			
Swift	Hitchin	May 7	A. H. Foster.
(*Cypselus apus*)	Watford	,, 11	W. Bickerton.
	St. Albans	,, 11	H. Lewis.
Nightjar	,, (New Farm)	,, 10	A. W. Dickinson.
(*Caprimulgus europæus*)			
Wryneck	St. Albans	April 3	A. Grey.
(*Iynx torquilla*)	Elstree	,, 8	E. P. Thompson.
Cuckoo	Harpenden	,, 9	J. J. Willis.
(*Cuculus canorus*)	Elstree	,, 10	E. P. Thompson.
	Bushey Heath	,, 11	P. J. Barraud.
	St. Albans	,, 11	A. Grey.
	Hatfield	,, 11	Miss E. Blackett.
	Sawbridgeworth	,, 11	H. S. Rivers.
	Watford	,, 13	W. Bickerton.
	Hitchin	,, 13	A. H. Foster.
	Odsey	,, 13	H. G Fordham.
	Broxbourne	,, 15	Rev. H. P. Waller.
Turtle-Dove	St. Albans (N.Fm.)	May 3	A. W. Dickinson.
(*Turtur communis*)			
Quail	Elstree	April 25	E. P Thompson.
(*Coturnix communis*)			
Landrail	St. Albans	April 24	A. Grey.
(*Crex pratensis*)	Hitchin	May 7	A. H. Foster.
	Munden, Watford	,, 12	W. Bickerton.

SECTION OF PALÆOLITHIC GRAVEL AT LONG VALLEY WOOD, CROXLEY, NEAR RICKMANSWORTH.

IX.

ON A RECENT PALÆOLITHIC DISCOVERY NEAR RICKMANSWORTH.

By Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., F.R.S.

Read at Watford, 2nd April, 1906.

(PLATES II and III.)

Eleven years ago, in the Anniversary Address to this Society in February, 1895,* I mentioned that some important discoveries of Palæolithic implements had been made in the valley of the Colne by Mr. Clouston, then resident at Watford.

In the second edition of my 'Ancient Stone Implements,' published in 1897 (p. 597), I made further mention of Mr. Clouston's discoveries, and on leaving the neighbourhood he kindly allowed me to add the specimens which he had found, including a well-formed and typical ovate ochreous implement, $4\frac{5}{8}$ inches long and $2\frac{5}{8}$ inches wide, to my collection. Nearly all came from gravels at the side of a new street known as Grove Road, Bushey. Another and much smaller implement made from a thick flake is of the pointed form, but has in old times lost its tip. Its original length was about $3\frac{1}{4}$ inches. It was found in the Back Lane, Old Bushey. A diligent search would doubtless lead to the discovery of more specimens.

As Local Secretary for Hertfordshire of the Society of Antiquaries of London, I communicated the account which I now submit to you to that body, and it appears in their 'Proceedings' for 14th December, 1905.

The discovery to which I now have to call attention is due to the acumen of Mr. Robert Barker, of the Briery Close, Croxley Green, near Rickmansworth, who in the summer of 1904, when examining the excavations for gravel being made by the Rickmansworth Gravel Company in Long Valley Wood, Croxley Green, found an ovate Palæolithic implement about 5 inches long and $3\frac{1}{4}$ inches wide. It is ochreous in colour, but its symmetry is slightly injured by its having lost a portion of one side in olden times.

Mr. Barker has another fine specimen found at a depth of 20 feet from the surface, and near the base of the gravel. It is of ochreous flint, sand-polished on the surface, of ovate pointed form, $6\frac{1}{2}$ inches in length and $3\frac{3}{8}$ in extreme breadth. Its greatest thickness is $1\frac{5}{8}$ inch. Both of these he has kindly presented to the Hertfordshire County Museum at St. Albans.

The workmen in the pits have now been trained to recognize the worked flints, and as the result I have been able to make a collection of 10 or 12 specimens, most of which are exhibited. They are of the usual types, for the most part of pointed ovate form, and varying in size from 7 inches by 4 to $3\frac{1}{2}$ inches by 2.

* 'Trans. Herts Nat. Hist. Soc.,' Vol. VIII, p. 169.

They also vary much both in colour and workmanship, some being ochreous while others are unstained, and some having the surface glossy while others are quite dull. Some, especially the larger specimens, are very roughly fashioned, while others have been chipped into shape in a most skilful manner. A fine flake of the so-called Moustier type, $5\frac{1}{8}$ inches long and $2\frac{5}{8}$ inches broad, was found about 26 feet below the surface. With it was a small ovate implement and the molar of an elephant to be subsequently mentioned.

The alluvial beds in which the implements occur extend in a south-westerly direction for about 600 yards along the right side of the valley of the Colne, and their base is from 30 to 40 feet above the existing level of the river. They are about 20 feet in thickness, and consist of sands, clay, and gravel, stratified in places. At one time a dark muddy layer a foot or more in thickness was exposed, which was probably the bottom of a small lake or pond and was originally almost horizontal. When exposed, however, it was much disturbed and distorted, in consequence probably of the unequal dissolution of the chalk below by means of the infiltrating water.

Its character will be seen in Plate III, from a photograph kindly taken by Miss Barker. The same lady has also been so good as to photograph the section in an excavation in the southerly part of the gravel beds (Pl. II). In another, more northerly excavation, the upper surface of the chalk has been exposed below the gravels. Most of the Palæolithic implements are said to have been found at a depth of 8 or 9 feet below the surface, but one of large size is stated to have been discovered immediately above the chalk under 5 feet of gravel and 15 feet of clay.

The constituent parts of the gravel are for the most part rolled and sub-angular flints, some of large size; but there are also blocks of Tertiary sandstone or Sarsen-stone, and considerable quantities of quartz and quartzite pebbles, no doubt derived from glacial deposits higher up the valley.

I have seen no land or fresh-water shells in the pits. As to mammalian remains, the workmen state that some time ago they came across a large bone in an almost vertical position, which was so friable that it crumbled away when touched. It is described as having been about 10 feet in length and about 6 inches in diameter, and there is little doubt that it must have been a large fossil tusk of an elephant. This view is confirmed by the recent discovery at a depth of 26 feet of a molar of an elephant, probably *Elephas antiquus*. This, however, was also in an extremely friable condition. The tusk would also appear to belong more probably to an animal of that species, as it does not seem to have presented the usual curvature of the tusks of *primigenius*.

SECTION OF GRAVEL AT LONG VALLEY WOOD, SHOWING BLACK BAND.

X.

WITCHES' BROOMS.

By James Saunders, A.L.S.

Read at St. Albans, 9th January, 1906.

PLATES IV–VI.

The abnormal growths, consisting of dense tufts of twigs, which sometimes occur on trees, are often assumed to be badly-constructed birds'-nests, and the resemblance in some cases is so misleading as to require close examination to detect the difference. They are, however, always due to a diseased condition of the plant affected, and although in the case of birch-trees the general health of the plant is apparently not injured, yet in the wild cherry large limbs are sometimes killed, and the organism as a whole is evidently enfeebled.

These growths are known as Witches' Brooms, Witches' Besoms, and Witches' Knots, names that have probably originated in the supposition that some occult influence, and therefore malevolent, had given rise to the abnormal developments. The following agents are those by which these growths are usually produced:—

A. *Parasitic fungi*, such as *Taphrina* (=*Exoascus*) and *Æcidium*. These are the most potent exciting causes.
B. *Phytophagi*, and possibly other insects.
C. *Gnarling*, i.e. an excessive development of leaf-buds on the branches or on the main stem; an obscure disease, the proximate cause of which is doubtful.

The following notes refer chiefly to the instances which have been observed in Beds and Herts, or more precisely within a radius of ten miles from Luton.

It is probable that some species of trees are affected by more than one agency, for further particulars of which attention is directed to the valuable work on 'Diseases of Plants induced by Cryptogamic Parasites,' by Karl von Tubeuf (English edition by Dr. William G. Smith). In this work, on pp. 152 and 153, a list is given of "species (of Exoasceæ) which cause Witches' Brooms," and of which "the asci are produced on the leaves." The enumeration includes both foreign and British deciduous trees which were known to be thus affected. They are: *Alnus incana* (Alder), **Betula verrucosa* (Birch), **B. pubescens*, *B. odorata*, **B. nana*, **Carpinus Betulus* (Hornbeam), **Prunus Cerasus* (Cherry), **P. Avium* (Wild Cherry), **P. institia* (Bullace), **P. domestica* (Plum), *P. pennsylvanica*, *Acer platanoides* (Maple), *Æsculus californica* (American Horse Chestnut).

Those marked with an asterisk (*) are native in the British Isles or have become naturalised.

In the district under consideration the following species bearing Witches' Brooms have been recorded within the last

three or four years, and in the succeeding notes the parasitic agent, when known, is also given: *Betula verrucosa* and *B. pubescens* (Birch), frequent; *Carpinus Betulus* (Hornbeam), frequent; *Prunus Cerasus* (Cherry), frequent; *P. Avium* (Wild Cherry), frequent; *Ulmus campestris* (Common Elm), rare; *U. montana* (Wych Elm), rare; *Corylus Avellana* (Hazel), occasionally; *Cratægus monogynia* (Hawthorn), rare; *Sambucus nigra* (Elder), very rare; *Abies excelsa* (Spruce Fir), Luton Hoo and Caddington, rare.

In addition to these the Silver Fir (*Abies pectinata*) has been shown to the writer by Mr. W. H. Burrell in North Norfolk, where it is not infrequent.

From the foregoing lists it may be inferred either that this district is rich in these productions or that they may have been more closely observed than is usual in so limited an area. It is moreover evident that there is room for original investigation in this department of natural science.

Wild Cherry (*Prunus Avium*, L.).—In May, 1904, on the south-west side of Rothampstead Park, Herts, Witches' Brooms were observed on wild cherry. The grove contains many of those trees, most of which were infested with these growths in a greater or less degree. In two instances nearly every branch was affected, and large portions of the trees were either decaying or dead. The leaves on the diseased parts were crumpled and coloured various shades of crimson. The groups of asci were visible with a lens on the under-side of the affected leaves, and the spores were easily distinguished with the necessary magnifying powers. The fungus is *Exoascus* (*Taphrina*) *Cerasi*, Sadeb.

Early in November, 1904, Mr. Arthur Staddon called my attention to the presence of a large broom on a tree in the Green Lane leading from Pepperstock to Markyate (Herts), about a mile from the latter place. On visiting the spot a few days later it was seen that the tree stands alone, and forms a conspicuous object (Pl. IV). It is of a considerable age, and at least one-half of it is affected. The diseased portion rises erect and overtops the normal branches some six or seven feet. The impression produced at first sight is that a tree of another genus has been grafted on the cherry. The healthy part showed many fruiting buds, but these were absent from the diseased portion.

Mr. Massee, in his 'Text-book of Plant Diseases,' says on p. 89: "This disease [Witches' Brooms of cherry], which is not uncommon on the Continent, is rare in Britain."

In May, 1905, the wild cherry trees (*P. Avium*) in the wood on Zouches Farm (Herts) were examined, when it was found that six of them were more or less infected with Witches' Brooms. The trees differed considerably in age, from quite juveniles to those which had attained full stature, and the extent of the disease varied greatly. As the examination was at the time of flowering, the brooms showed in sharp contrast to the healthy portions of the trees. The latter were crowded with

Broom on Wild Cherry, Markyate, Herts.

blossoms, whilst the diseased branches were quite destitute of flowers. In several instances these rose erect, overtopping the other parts by several feet.

CULTIVATED CHERRY (*Prunus Cerasus*, L.).—An old cherry-tree at Chaul End formerly sustained two Witches' Brooms, the branches which bore them having been blown off in a gale during the autumn of 1903. These growths were most conspicuous during the period of blossoming, as they produced no flowers. The diseased condition was due to the presence of *Exoascus Cerasi*, Sadeb. (*E. deformans* β *Cerasi*, Fuckel). The asci were easily distinguished on the under surface of the leaves in June and July. The spores were pale yellow, nearly smooth, elongate, with a thin epidermis; their dimensions were about 6 by 12 μ. The leaves were crumpled and of various shades of crimson.

In the orchard of Top Street Farm, Harpenden, there are several trees infested with these parasitic growths. The usual characters are present in a marked degree, the most conspicuous of which are, the absence of flowers and fruit, the crumpling of the leaves, and their dark crimson hue. The productiveness of the trees must be seriously diminished by the presence of these abnormal conditions.

HAWTHORN (*Cratægus Oxyacantha*, L., var. *monogynia*).—In April, 1904, a fine example of Witches' Broom on an old hawthorn bush was observed at Chaul End, on the Lynchets, which are so marked a feature of the Chalk hills at that place. The locality has a north-east aspect, which implies a diminished amount of direct sunshine. The hawthorn was a very old one, and the broom was not less than three feet in diameter; the branching was very dense and tortuous, with a great accumulation of dead twigs. When first observed on 17th April the living portions of the broom were just unfolding their leaves, which were smaller and more crowded than those on the healthy branches. On a subsequent visit at the end of July, it was noticed that many of the twigs on the broom had recently withered, as the leaves on them were prematurely dead. The foliage of the living twigs showed numerous brown patches, which under a microscope exhibited asci and numerous nearly spherical spores.

In January, 1905, two large isolated hawthorns were observed in Stockwood Park, Luton, which were infested with these growths. There were at least half a dozen large brooms on each of them, and on one a primary branch was seen to have been killed by the disease. The brooms were conspicuous by reason of their barrenness, as they showed in sombre contrast with the healthy portions of the trees, which were laden with their red fruits that gleamed in the winter sun. The branching of the brooms was different from that of the healthy portions of the trees, and many of the twigs were strangely distorted. There was also the usual abundance of dead twigs on the brooms.

The references to this disease of the hawthorn which have come under the writer's notice are as follows:—"*Exoascus Cratægi*, Fuck., occurs on *Cratægus Oxyacantha*, and causes red swellings on the leaves and flowers, accompanied by hypertrophy of shoots, in which the mycelium perennates" (Tubeuf, 'Diseases of Plants,' p. 166). "*Taphrina Cratægi*, Sadeb., *Exoascus bullatus* β *Cratægi*, Fuckel, affects the leaves of hawthorn and fruits, May to June" ('Bot. Zeitung,' 1895).

Elder (*Sambucus nigra*, L.).—A growth analogous to the subject under consideration was first noticed in March, 1904, on an elder at Round Green, near Luton, at the corner where the road turns for Stopsley. The tree was an old one, certainly over fifty years of age, and a gardener living in an adjoining cottage stated that seventeen years previously he had cut back all the branches to the main stem, and that the peculiar growth on the tree first appeared about 1899. The broom (or *rake*) occurred on one of the principal branches, which curved downwards; and from it, rising erect over a length of three or four feet, were a number of curious growths, somewhat resembling candelabra. Most of them were thicker than the branch from which they proceeded. They were also spindle-shaped, the thickest portion being a short distance above the point of origin.

On a subsequent examination of the tree it was found that these abnormal branches were all dead, and had been so for some time, as decortication had commenced on most of them. By the aid of a field-glass it could be seen that the lenticels on them were much larger than those on the normal branches. This curious growth formed a conspicuous object both in summer and winter.

In none of the books to which the writer has access are there any references to this disease of the elder, but judging from analogy it is fairly safe to assume that it is caused by a parasitic fungus.

The phenomenon is certainly rare, as although many thousands of elders have been examined during the last two years in this and other parts of the country, none of them has been seen with similar growths. It is, however, within my recollection that some twenty-five years ago an exactly similar development was observed on an elder-tree, and although the precise locality is forgotten it was somewhere in South Beds or North Herts.

Common Elm (*Ulmus campestris*, Sm.).—A fine example of Witches' Broom occurs on a large elm-tree in the 'Poplar Field,' Limbury. It grows on a lateral branch, about three feet from the main stem, its dimensions being about eighteen inches in height and nine inches in thickness. It forms an irregular cylinder, the external part consisting of a dense growth of erect twigs, a small proportion of which are living and the remainder dead. The central part is hollow, and contains dead leaves and fragments of twigs.

On 24th April, 1904, an examination of this tree showed that the leafing both of the broom and the normal branches was

apparently coincident. In July the leaves on the broom were seen to be in a damaged condition. Most of them appeared to have been partly eaten by larvæ, and on many of them were brown patches suggesting the presence of a parasitic fungus. In September all the leaves of the broom had withered and fallen, whilst those of the healthy part of the tree were assuming their normal autumn tints. Many of the latter were marked with brown spots, on which were numerous asci containing elongate spores, probably the fruiting-stage of *Taphrina Ulmi*, Johan. (*Exoascus Ulmi*, Fuckel). In 'Bot. Zeitung,' 1895, this species is described as occurring on leaves of elm from June to October.

In Stockwood Park, Luton, there are other examples on common elm. On one of these is a broom very similar in appearance to that at Limbury. It grows on a tree not less in age than one hundred years, and the broom is much older than that referred to above. Another elm, also an aged one, which is probably the largest tree in Stockwood Park, is infested with these parasitic growths. Some of them are living and others dead. Two of the latter now appear as large excrescences on primary branches, and must have taken many years to produce. Another large broom is in a moribund condition, and bears only a few living twigs. These excrescences mark the places where the parasitic fungus has effected the maximum of injury to the tree.

On Brewer's Hill, Wheathampstead, there is a fine example on common elm, which was first observed by the writer on 8th May, 1904. It is a conspicuous object, and can be seen from the distance of a mile when approached from Harpenden. It occupies the highest part of a tree which has an altitude of not less than fifty feet. The broom is about three feet in height and five in width. By the aid of a telescope it was seen that the foliage was crumpled, as well as smaller and more crowded than on the normal part of the tree.

Dr. W. G. Smith, in a letter dated 14th January, 1904, writes to me: "Re *Ulmus*, the only *Taphrina* on it at present known is a leaf-form which does not produce witches' brooms. I recently saw the manuscript of an investigation which dealt with gnarling, and these growths on elm were traced to this cause. A few years ago the Botanical Department at Manchester University secured a splendid specimen of elm broom. They consulted with me about it, but in spite of careful investigation they could find no *Exoascus*. From my own examination I am inclined to put the elm brooms down to abnormal growth, without reference to fungi or insects."

The evidence of the elms in Stockwood Park is strongly suggestive of the presence of a parasitic fungus, which is probably the agent in the formation of the brooms that they produce. The balance of evidence of the Limbury specimen is in favour of gnarling as the proximate cause.

Wych Elm (*Ulmus montana*, Sm.).—A small broom is present on a large wych elm at the Bedford Road end of Villa Road,

Luton. In this instance, as in the common elm at Limbury, the broom rises erect from the branch from which it originates. The compact, ascending habit of the branches of the broom is very unlike the diverging branching that is so characteristic of the wych elm. The elevated position of the broom renders a close inspection impracticable. In the early months of the years 1904 and 1905 there were no flower-buds on the broom, although the highest branches of the tree were covered with them. On 24th April, 1904, the leafing of this tree and its associated broom appeared to be simultaneous. On 24th August, 1904, the foliage of the broom was all withered except on two or three very young twigs. By 17th September all its leaves had fallen, while those of the healthy portions of the tree remained in position for a fortnight later.

Birch (*Betula alba*, L., and *B. verrucosa*, Ehrh.).—The silver birch, including at least the two forms *B. verrucosa* and *B. glutinosa*, is peculiarly susceptible to the disease under consideration, and the curious growths on these trees usually arrest attention from their striking resemblance to badly-constructed birds'-nests.

The exciting cause is the presence of a parasitic fungus, *Exoascus Betulinus*, Rostr. (=*E. turgidus*, Sadeb.). In 'Country Life,' 28th May, 1904, p. 792, it is stated that "The mycelium is very minute and works just below the bark, stopping the proper development of the part it attacks, and causing this mass of sickly shoots."

The fruiting-stage appears on the under-side of the leaves in May and June, and can easily be seen with a pocket-lens; a much higher power being necessary to distinguish the structure of the asci and contained spores. The disease is always accompanied by a crumpling of the leaf.

The affected twigs are short-lived, usually not attaining a greater age than two or three years, sometimes only one. Other small branches are developed in succession, so that each broom contains a large proportion of dead material as well as living. Hence the opaque appearance of the older growths.

This disease is quite distinct from another to which these trees are subject. In this the leaves are infested by minute mites, *Eriophyes rudis*, Canestrini, the irritation set up by them causing a number of diminutive brooms to appear as outgrowths from the diseased buds. (See 'Country Life,' 28th May, 1904.) This is confirmed by Mr. E. Connold, the author of a work on British Galls, in a letter to the writer dated 29th April, 1902.

A fine example of Witches' Brooms on birch is present in the grounds of Mr. G. Plummer, The Villas, Luton. The tree has borne these growths for at least 25 years, and the brooms become more numerous with advancing age, so that at the time of writing (1906) there are on it at least thirty masses, varying in size from a few inches to several feet in diameter. Although so laden with these parasitic growths, the general health of the tree does not

BROOM ON BIRCH, GROVE PARK, WATFORD.

appear to be injuriously affected. The striking appearance of the tree has commanded so much attention that a representative of the firm of Messrs. Lane, of Berkhamsted, the well-known horticulturists, called on Mr. Plummer, as a client had requested Messrs. Lane to supply him with a similar tree, which was evidently impracticable, even had they desired to do so. Mr. Plummer states that the foliage of the brooms opens before that of the normal branches, and also fades earlier. These growths bear a few male catkins, which, with the accompanying foliage, furnish unmistakable evidence of the attacks of a parasitic fungus. All the brooms on this tree are pendent, whereas a single broom on a birch at Wardown, about a quarter of a mile distant, is erect. There are several instances of Witches' Brooms occurring on birch-trees in the immediate vicinity of Watford, examples of which are shown on Plate V.

A description of these growths appears in the translation by Dr. W. G. Smith of Tubeuf's 'Diseases of Plants,' p. 160, which is here quoted entire: "On close examination of brooms which undoubtedly bore *Exoascus*, I found that a broom results from the prolific development of small twigs on a few knotty swollen parts of a branch. Each central knot we may regard as the position of the bud which was first infected, and from which the broom-system took its origin. As one result of the attack of the fungus, the greater number of the buds in the axils of the scales of the infected bud have grown out as twigs, but not into well-developed ones. In consequence, nearly every twig has been killed back by the winter, but not completely, so that from each twig-base have sprung a new crop of stunted immature twigs like the first, and equally liable to be killed in the following winter. Thus has arisen that tangled mass of dead or sickly birch twigs which we call witches' brooms."

HORNBEAM (*Carpinus Betulus*, L.).—For several years prior to 1901, Witches' Brooms were plentiful on hornbeam (Pl. VI) in a plantation near Chaul End, about a mile south-west from Luton. During that year the trees and shrubs were cut down and the brooms destroyed. At this place the growths were pendent, probably owing to the comparative youth of the trees, none of them exceeding 25 or 30 years of age. The growth of foliage on the brooms was excessive, which caused the affected branches to droop by gravitation. Most of them closely resembled the figure in Tubeuf's 'Diseases of Plants,' p. 160, except that they were pendent instead of erect as shown in his illustration. The largest specimen met with in this locality was forwarded to the British Museum, South Kensington, where it is exhibited in the public gallery; and Mr. Britten remarked that it was the finest example which had come into their possession. The leaves on these growths were smaller than the type, crowded, crumpled, and variously coloured, ranging from greenish pink to deep crimson. Dr. W. G. Smith, in a letter dated 14th January, 1904, ascribes this disease to *Exoascus Carpini* (=*Taphrina Carpini*),

and says: "the asci occur on the leaves in June and July. I found them on the one figured in Tubeuf, p. 160, and the same opinion is expressed by the authors of a 'Text Book of Botany,' 1903, which was the joint work of four German professors." Thanks to the skill in microscopic work of Mr. W. H. Burrell, the presence of this fungus was detected on the leaves of a broom from Chaul End. Mr. Burrell remarked in a letter of 2nd July, 1901: "the under surface of the leaves showed many spores."

In Stockwood Park, near Luton, a hornbeam-tree, probably at least 100 years old, was first observed in February, 1904, to have produced as many as ten large brooms. In this instance the branching of these growths was more open, and the winter-buds were smaller than on the normal branches. The twigs were tortuous, and the nodes swollen and distorted. In each example the point of origin of the broom was much distended; the branch ceased to extend laterally, and with one exception assumed an erect position; in the latter instance it was pendent from an attenuated branch of about ten feet in length. At a casual glance it appeared as though the branches had been cut off, and the broom had developed from the point of injury, but upon a closer inspection it was evident that the apices of the branches had curved upwards, the growth being continued in that direction. In some cases there was an interval of six or eight inches beneath the group of branchlets which formed the broom, and above the origin of the curvature. (See fig. 1.)

In August of the same year, it was observed that many of the leaves were partially withered, suggesting the presence of a parasitic fungus. Microscopic examination proved the presence of the fruiting-stage of a *Taphrina* on the under surface of the foliage. The spores were brown, ovoid, nearly smooth, and measured about 6 by 9 μ. The parasite was *Taphrina Carpinus*, Rostr. (=*Exoascus Carpini*, Rostr.). The brooms on this mature tree were very different in general appearance from those on the young trees at Chaul End referred to above.

On an old hornbeam-tree on Beech Hill, Luton, there are two small brooms on the higher branches which resemble those in Stockwood Park just described. On a neighbouring hornbeam, the trunk of which is about six feet in circumference, there is on the main stem a dense growth which occurs just below the origin of the main branches and extends over quite one-half of the girth of the tree. The twigs are small, rarely branched, and short-lived, the last point being attested by the great proportion of dead twigs which are present. There are no large branches to continue the growth outwards indefinitely, but all the branchlets extend to nearly the same distance from the tree-trunk. On 2nd August, 1904, twigs from this growth were gathered on which many of the leaves showed brown spots, resembling the diseased condition that is due to the presence of a parasitic fungus. They were carefully examined under a microscope, and no traces of spores or mycelium-threads could be detected. They

were, however, found to be infested with mites, many of which were so minute as to be scarcely discernible with a pocket-lens. In this instance the abnormal growth was probably caused by the presence of these insects, or if due to gnarling, then the crowded condition of the twigs rendered them peculiarly susceptible to the attacks of the minute creatures. A similar occurrence had been observed two days previously on a large beech-tree at Chaul End. A dense growth of weak twigs had developed on the main stem where the principal branches were given off. These twigs and the leaves upon them were swarming with mites, but whether

FIG. 1.—Erect broom on Hornbeam (*Carpinus Betulus*, L.). Stockwood Park, Luton. Photographed by Mrs. A. Staddon. A foot-rule (30·5 cm.) is beneath it.

this growth was due to gnarling, or to the irritation set up by the multitude of parasitic insects, it is difficult to determine. The balance of evidence favours the latter assumption. When present the mites hybernate in the terminal buds, and as they divert the nutritive element, atrophy of branches is the result.

A very old Witches' Broom occurs on a distorted hornbeam in a hedgerow by the side of the road which leads from Wheathampstead to the Bowling Alley, Harpenden, Herts. It has the appearance of having been caused by a *Taphrina*. It was flourishing in May, 1904.

Wehmer, in 'Bot. Zeitung,' 1896, discusses the formation of these Witches' Brooms ('Diseases of Plants,' Tubeuf, p. 163, foot-note).

HAZEL (*Corylus Avellana*, L.).—Examples of Witches' Brooms were observed in April, 1904, on several hazels on the Lynchets at Chalk Farm near Caddington. The aspect of the position is northerly, which, by reason of diminished sunshine, may render the vegetation more susceptible to disease than if it were southerly. For about a mile on this part of the range of hills, Witches' Brooms were numerous on several species of trees, particularly hazel and hornbeam. The hazels are aged and crowded, and the brooms were developed on the ends of the branches. Most of the diseased twigs bore staminate catkins, and although not observed at that date they must have produced pistillate tufts also, as upon a subsequent visit in Midsummer a few immature nuts were found on them. The catkins and leaf-buds at the time of unfolding were much smaller than those on the healthy branches. All the brooms contained a considerable proportion of dead twigs, and in some cases decay extended for several feet from the extremities of the branch. This is a feature common to most of these growths. The small branches live but a few years, in this respect differing from most of the normal ones, which continue to grow indefinitely, their existence usually terminating only with that of the tree which bears them. Upon examining the bushes in the following July it was found that many of the leaves showed brown patches, which upon examination were found to contain both asci and spores; the latter were ovate and minutely dotted. They were evidently the fruiting-stage of a *Taphrina*.

SPRUCE FIR (*Abies* (*Picea*) *excelsa*).—In July, 1905, Mr. A. Staddon called my attention to a broom on a spruce fir in Luton Hoo Park (Pl. VI). The growth was very dense, the branches were abbreviated, and the leaves were more crowded and spreading than in the type. The foliage was also shorter, averaging 8 to 10 millimetres in length, whilst the normal leaves were 13 to 14 millimetres.

The tree was examined again on 25th December, 1905. It was then seen that the leaves of 1904 had all withered and many of them were fallen, whilst the foliage of 1905 was green and vigorous. A close examination of the withered 1904 foliage revealed the presence of the fruiting-stage of a fungus, which showed as dark spots, exserted from the stomata. Under the microscope numerous mycelium-threads and light-coloured spherical spores were seen.

On 14th January, 1905, in a wood at Caddington, another spruce fir was observed which bore a Witches' Broom, very similar to the one at Luton Hoo. Specimens of this were sent to Mr. W. H. Burrell, who kindly examined the leaves and prepared micro-slides from them of transverse sections. In an accompanying letter Mr. Burrell remarked that "The resin

Broom on Spruce Fir and Hornbeam, Luton.

ducts in the mesophyll are degraded, and they do not show the usual ring of small thin-walled cells by which they should be surrounded. The hypodermal cells are interrupted at intervals by the stomata, and here in a number of instances the mycelium is knotted and twisted as if it were thrusting its way through, and possibly during the proper season conidia were liberated from the protruding hyphæ." Tubeuf says: "*Æcidium coruscans* forms malformed shoots in spruce. In Russia and Scandinavia *Æcidium abietinum* does not appear to cause witch brooms." Kerner says: "Witches' brooms also occur on pines, larches, and spruce firs, etc., although hitherto we have not been able to ascertain definitely what parasitic fungi are the causes in these cases."

Silver Fir (*Abies pectinata*).—Witches' Brooms on silver fir are not uncommon in North Norfolk on sandy soil. An account of this, by Mr. W. H. Burrell, appears in the 'Transactions of the Norfolk and Norwich Naturalists' Society,' vol. vii. Although no records of similar growths in this district are known to the writer, yet it is highly probable that they would be found if sought over the Lower Greensand area. In the case of the silver fir the disease is due to the presence of one of the Uredinæ, *Æcidium elatinum*. The foliage of the brooms is deciduous, whilst the leaves of the normal shoots persist for several years.

Numerous records were made during 1904 as to the relative unfolding and fading of the leaves on Witches' Brooms, and of the normal branches of the trees which bear them.

From lengthened observations by Mr. G. Plummer, it appears that in the case of the birch on his grounds the leaves of the brooms both unfold and wither earlier than on the other portions of the tree.

In field elm, wych elm, hornbeam, hazel, and hawthorn, so far as could be judged in the springtimes of 1904, 1905, and 1906, the development of the foliage on the brooms and on the healthy portions of the trees was simultaneous, but in all cases the withering of the leaves was earlier on the brooms than on the normal branches.

The local effects of the exciting causes of the brooms are manifested in the crumpling of the leaves, their smaller size, usually also their more brilliant colouring, and the atrophy of the twigs. The general effects are an acceleration of development, accompanied by diminished vitality, which results in a shortening of the lives of the parts affected, and in extreme cases of the life of the whole organism. Fruit is also usually absent.

Dr. W. G. Smith informs me that a theory has been advanced by Dr. Kiegenhagen, which assumes that the primordial type of a genus of trees possessed (or was possessed by) its special parasite, and that in the course of subsequent evolutionary changes both host and parasite became specialized along parallel lines.

My best thanks are due to Dr. W. G. Smith for his valuable assistance in tracing the literature of the subject; to Mrs. Arthur Staddon and to Mr. Norwood for their kindness in photographing some of the more instructive examples; and to Mr. W. H. Burrell for the preparation of micro-slides.

Explanation of the Plates.

PLATE IV.

Broom on Gean or Wild Cherry (*Prunus Avium*, L.). Markyate, Herts. Photographed by Mrs. A. Staddon.

PLATE V.

Broom on Birch (*Betula alba*, L.). By canal between Grove Park and Lady Capell's Wharf, Watford. Photographed by John Hopkinson, April, 1906.

PLATE VI.

Upper part.—Spruce Fir (*Abies excelsa*, De C.). Luton Hoo Park. The top figure represents a dead broom; the left-hand figure, a normal branch of three years' growth, showing the foliage of each year; the right-hand figure, broom showing defoliation of previous year's leaves. Photographed by W. J. Roberts.

Lower part.—Pendent broom on Hornbeam (*Carpinus Betulus*, L.). Chaul End, Luton. The original is in the British Museum.

XI.

OSTRACODA AND MOLLUSCA FROM THE ALLUVIAL DEPOSITS AT THE WATFORD GAS WORKS.

By JOHN HOPKINSON, F.L.S., F.G.S., F.R.M.S., etc.

Read at Watford, 2nd April, 1906.

THE Alluvial deposits of Holocene age, exposed at the Watford Gas Works in excavating for a new gasometer, were examined at a field meeting of the Society on the 3rd of May, 1902, and a paper describing them was read before the Society by Dr. T. E. Lones, and published in our 'Transactions,' Vol. XII, p. 18. An account of the field meeting appeared in the previous volume (XI, p. xli). In this account I gave a list of eighteen species of land and fresh-water Mollusca then collected in the grey marl which formed the old river-bed of the Colne when flowing at a considerably higher level than it does at the present time. Suspecting the occurrence of Ostracoda in this marl, I sent, a few days later, a small box-full to Mr. Frederick Chapman, A.L.S., who has made a special study of this subject, and has contributed a paper to our Society on "Ostracoda from the Chara-Marl of Hitchin." Unknown to me, Mr. Chapman had then left this country for Australia, and a few months ago I received from him the following letter, written from the National Museum, Melbourne, 6th September, 1905:—

"Some years ago (17th May, 1902) you very kindly sent, to my London address, which I had then left for Melbourne, a box of loam from the old bed of the River Colne at Watford, in the hope that it might yield some forms of Ostracoda. When the material reached me in Melbourne I believe I wrote to you concerning it, and promised to look at it later on. My friend Mr. A. D. Hardy, of the Lands Department, Melbourne, told me the other day that he had heard from you, and reminded me of my promise to look at the Ostracod material. I am sorry that you should have had to wait so long for my response, and I send herewith the results of my examination of the sample. . . .

"OSTRACODA. — Well-preserved but exceedingly rare; one specimen only of each of the species mentioned: *Candona candida*, O. F. Müll.; *C. pubescens*, Koch; *Ilyocystis Bradii*, G. O. Sars; *Limnicythere inopinata*, Baird.

"MOLLUSCA.—*Helix rotundata*, Müll.; *Succinea putris*, Linn.; *Planorbis albus*, Müll.; *P. glaber*, Jeffr.; *P. lineatus*, Walker; *Bythinia tentaculata*, Linn. (opercula only); *Sphærium corneum*, Linn., var. *pisidioides*, Gray."

Mr. Chapman's communication not only adds to our sub-fossil fauna four species of Ostracoda, but also adds four species of Mollusca to those before determined, these species being *Planorbis albus, glaber*, and *lineatus*, and *Sphærium corneum*.

The following is a complete list of the Land and Fresh-water Mollusca which have now been determined from this bed:—

Helix rotundata, *Müll.*
H. nemoralis, *Linn.*
H. hortensis, *Müll.*
H. arbustorum, *Linn.*
H. caperata, *Mont.*
Pupa muscorum (*Linn.*).
Cochlicopa lubrica (*Müll.*).
Succinea putris (*Linn.*).
Planorbis lineatus (*Walk.*).
P. albus, *Müll.*
P. glaber, *Jeffr.*
Planorbis spirorbis, *Müll.*
P. vortex (*Linn.*).
P. carinatus, *Müll.*
P. contortus (*Linn.*).
Physa fontinalis (*Linn.*).
Limnæa peregra (*Müll.*).
L. palustris (*Müll.*).
Bythinia tentaculata (*Linn.*).
Sphærium corneum (*Linn.*).
Pisidium amnicum (*Müll.*).
P. fontinale (*Drap.*).

With the exception of *Planorbis lineatus* and *glaber*, all these species have been found in the neighbourhood of Watford in a living state, but the two named have not before been recorded for Hertfordshire. *Pupa muscorum* has been recorded from Aldenham under the name of *P. marginata*, Drap.

XII.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1905.

By Edward Mawley, F.R.Met.Soc., F.R.H.S., V.M.H.

Read at Watford, 2nd April, 1906.

All parts of the county are well represented with the exception of the north-east portion, which unfortunately still lacks an observer. During the past year the Society has lost two of its phenological observers, one at Watford and another at Hatfield, but as there were previously two observers in both localities, the number of observing stations remains the same as in the last report.

The following table gives the list of observers, the districts they represent, and the approximate height of the stations above sea-level. Three of the stations are just outside our county boundary, Harefield being in Middlesex, Chesham in Bucks, and Odsey in Cambridgeshire. The sequence is from south to north.

Station.	Height above Sea-level.	Observer.
Harefield (The Scrubbs)	340 feet.	G. E. Eland.
Watford (Weetwood)	270 ,,	Mrs. J. Hopkinson.
Chesham (Cannon Mill Cottage)	300 ,,	Miss G. Keating.
Broxbourne	120 ,,	Rev. H. P. Waller.
St. Albans (Worley Road)	300 ,,	H. Lewis.
St. Albans (New Farm)	400 ,,	Miss A. Dickinson.
Berkhamsted (Rosebank)	400 ,,	Mrs. E. Mawley.
Hatfield (St. Michael's)	380 ,,	Miss R. Blackett.
Hertford	140 ,,	W. Graveson.
Sawbridgeworth	240 ,,	H. S. Rivers.
Harpenden (Hecla Villa)	370 ,,	J. J. Willis.
Hitchin	230 ,,	A. W. Dawson, M.A.
Odsey, Ashwell	260 ,,	H. G. Fordham.

The Winter of 1904–5.

There have been in this county only four warmer winters than this in the last nineteen years. The only cold period occurred about Christmas and lasted nine days, and at no time did the exposed thermometer at Berkhamsted show more than 15 degrees of frost, which is an exceptionally high extreme minimum for the quarter. A good deal of rain fell during the first half of December, but after that time the weather continued remarkably dry until nearly the end of the season. This was not only a very warm and dry winter, but also an exceptionally sunny one, the duration of bright sunshine at Berkhamsted exceeding the average by as much as twenty-three minutes a day.

The work on the farms, owing to the exceptionally favourable character of the autumn, was in so forward a state and so much corn had been already sown, that the hindrance caused by the wet weather in the early part of December was much less felt than it otherwise would have been. In fact, this wet period was welcomed, as the rain made the soil, which had been loosened by the frosts at the end of the previous month, firm round the young wheat. Throughout January the ploughing of the land proceeded without any interruption. So that during February, which was also a dry month, the sowing of spring corn took place under remarkably favourable conditions. Indeed, owing to the beneficial influence on the soil of the continued dry weather and the occasional frosts in January, seldom have spring wheat and oats been provided with such an excellent seed-bed, and never was there a winter giving a better opportunity of ploughing and cleaning the land. So that at the end of the season the autumn-sown cereals presented a most promising appearance. The dryness and mildness of the winter and the plentiful supply of roots allowed the cattle and sheep to make good progress, and to continue unusually healthy throughout the season. The only drawback appears to have been the scarcity of water in the ponds, etc., due to the scanty rainfall of the autumn and winter months.

This proved an equally satisfactory winter in the garden. For during almost the whole season the preparation of the ground for spring crops and the planting of fruit-trees, shrubs, etc., could be carried out under the most favourable circumstances as regards both weather and soil. The absence of anything like severe or prolonged frost also enabled the supply of green vegetables to remain fresh throughout the whole winter. The keen frosts at the end of November had cut off most of the flowers then remaining, so that there were scarcely any to be seen in the gardens in the early part of the season.

The winter aconite came first into blossom in my garden on the 8th of January, which is eleven days earlier than its average date of first flowering in the previous sixteen years, and with two exceptions earlier than in any of those years.

Taking the county as a whole, the first fertile flowers appeared on the hazel six days later than the average date for the previous twenty-nine years. The song-thrush was first heard after the beginning of the year nine days in advance of its mean date, while the honey-bee was first seen to visit flowers fourteen days later than usual.

The Spring.

March proved throughout an exceptionally warm month, while the mean temperatures of April and May were about seasonable. On one night in May the exposed thermometer at Berkhamsted registered 9 degrees of frost—or greater cold than had been previously recorded there so late in the month during

the previous nineteen years. March was very wet, and during April small amounts of rain fell at frequent intervals, but for four weeks in May there was scarcely a drop of rain. Taking the quarter as a whole the record of bright sunshine was about seasonable.

The continued wet weather in the middle of March brought the sowing of spring corn to a standstill, and although it was resumed at the end of that month the ground was never afterwards in as good condition as it had previously been. In May the planting of mangolds, swedes, turnips, and potatoes was carried out in a dry seed-bed. The grass in the meadows and pastures which promised so well during the early part of the season received a severe check in May owing to the cold nights and long drought. So that before the end of the spring the previous prospect of an abundant yield of hay was at an end. Notwithstanding the heavy rainfall in March and the long period of dry weather in May, the autumn-sown corn, and particularly the wheat, still continued to make satisfactory progress, but these adverse conditions proved trying to the late-sown spring corn, which had not been as well sown and had as yet obtained but imperfect root-hold of the ground. The early potatoes were in many places cut down by frost, and particularly was this the case where they happened to be growing in low-lying situations.

In the garden this proved almost as trying a spring as on the farm, owing to the saturated state of the ground in March, the frequent falls of rain in April, and the long spell of dry weather in May. The fruit-tree blossom on the apples, pears, and plums was abundant, but nearly the whole of it was destroyed by the keen frosts of the 22nd and 23rd of May.

In order to give some idea as to the dryness of the soil in the last month of the season, I may state that no measurable quantity of rain-water came through my bare soil percolation gauge during the twenty-three days ending May 29th.

Our observer at Harpenden states that on May 22nd a little snow and hail fell, which were followed at night by a severe frost which cut down potato haulms. On the same night much damage is reported to have been done by frost at Hertford.

Taking the county as a whole, the coltsfoot was one day late, and the wood-anemone nine days late, whereas the blackthorn, garlic hedge-mustard, and horse-chestnut were each two days early, and the hawthorn three days early. On the other hand, the white ox-eye was seven days late.

The spring migrants arrived, as a rule, slightly behind their average dates, the swallow and cuckoo being each one day late, the nightingale three days late, and the flycatcher thirteen days late.

The wasp made its appearance sixteen days early, the small white butterfly eighteen days late, and the orange-tip butterfly nine days late.

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1905, WITH THE MEAN DATES FOR 1876–1904.

SPECIES.	HARE-FIELD.	WAT-FORD.	CHES-HAM.	BROX-BOURNE.	ST. ALBANS (New Farm).	BERK-HAMSTED	HAT-FIELD.	HERT-FORD.	SAW-BRIDGE-WORTH.	HAR-PENDEN.	HITCHIN.	ODSEY (Ashwell)	MEAN FOR THE 29 YRS.
Hazel (*Corylus avellana*)	Feb. 5	Feb. 8	Feb. 8	Feb. 10	Feb. 1	Feb. 9	Feb. 10	Jan. 15	Feb. 3	Feb. 2	Feb. 5	Jan. 29	Jan. 29
Coltsfoot (*Tussilago farfara*)	Mar. 19	Mar. 9	.....	Mar. 5	....	Feb. 5	.....	Feb. 17	Mar. 7	Feb. 27	Mar. 12	Feb. 28	Mar. 1
Wood-Anemone (*Anemone nemorosa*)	Apl. 9	Apl. 10	.....	Mar. 24	Mar. 22	Apl. 2	.....	Mar. 23	Apl. 1	Apl. 13	Mar. 26	.....	Mar. 23
Blackthorn (*Prunus spinosa*)	Apl. 4	Apl. 7	Mar. 30	Apl. 5	Apl. 3	Apl. 9	.....	Mar. 23	Mar. 28	Apl. 1	Apl. 2	Apl. 6	Apl. 4
Garlic Hedge-Mustard (*Alliaria officinalis*)	.....	Apl. 18	Apl. 19	.....	Apl. 15	Apl. 25	.....	Apl. 6	Apl. 26	Apl. 19	Apl. 13	.....	Apl. 20
Horse-Chestnut (*Æsculus hippocastanum*)	May 8	May 7	May 12	.....	May 6	May 9	May 2	May 5	May 10	May 5	May 2	.....	May 9
Hawthorn (*Cratægus oxyacantha*)	May 4	May 5	May 15	.....	May 13	May 24	May 8	Apl. 30	May 16	May 10	May 8	.....	May 13
White Ox-Eye (*Leucanthemum vulgare*)	.....	May 23	May 19	.....	May 27	May 27	May 29	May 25	....	June 6	.....	.....	May 20
Dog-Rose (*Rosa canina*)	June 2	June 3	June 14	June 11	June 3	June 2	June 3	May 31	.....	June 10	June 2	June 5	June 6
Black Knapweed (*Centaurea nigra*)	June 21	June 14	July 17	.....	June 14	July 12	.....	June 26	.....	July 8	.....	.....	June 27
Harebell (*Campanula rotundifolia*)	July 11	.....	....	.....	.....	July 11	July 18	July 6	.....	July 22	.....	.....	July 6
Greater Bindweed (*Convolvulus sepium*)	.....	.....	July 5	.....	.....	July 3	.....	July 13	.....	.....	.....	.....	July 9
Ivy (*Hedera helix*)	.....	Sept. 28	Sept. 16	Sept. 24	.....	Sept. 17	.....	Sept. 21	Sept. 30	.....	Sept. 15	Sept. 20	Sept. 27

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1905, WITH THE MEAN DATE FOR 1876–1904.

SPECIES.	HARE-FIELD.	WAT-FORD.	CHES-HAM.	BROX-BOURNE.	ST. ALBANS.		BERK-HAMSTED.	HAT-FIELD.	SAW-BRIDGE-WORTH.	HAR-PENDEN.	HITCHIN.	ODSEY (Ashwell)	MEAN FOR THE 29 YRS.
					WORLEY ROAD.	NEW FARM.							
BIRDS.													
Song-Thrush (*Turdus musicus*)	.....	.....	.....	Jan. 4	Jan. 9	Jan. 5	Jan. 8	Jan. 9	Jan. 9	.....	Jan. 9	.....	Jan. 17
Swallow (*Hirundo rustica*)	Apl. 16	Apl. 20	Apl. 7	Apl. 16	Apl. 6	Apl. 11	Mar. 28	Apl. 12	Apl. 11	Apl. 14	Apl. 12	Apl. 29	Apl. 12
Cuckoo (*Cuculus canorus*)	Apl. 12	Apl. 20	Apl. 11	Apl. 15	Apl. 11	Apl. 12	Apl. 26	Apl. 11	Apl. 11	Apl. 9	Apl. 12	Apl. 13	Apl. 13
Nightingale (*Daulias luscinia*)	Apl. 13	Apl. 13	.....	Apl. 17	Apl. 13	Apl. 12	Apl. 21	Apl. 23	Apl. 23	Apl. 29	Apl. 16	Apl. 16	Apl. 15
Spotted Flycatcher (*Muscicapa grisola*)	.....	.....	.....	June 2	.....	May 26	May 27	.....	May 22	.....	.....	May 25	May 14 (12 years)
Swallow (last seen) (*Hirundo rustica*)	Oct. 17	Oct. 16	Oct. 1	Nov. 17	Oct. 20	Oct. 18	Oct. 14	.....	Oct. 29	.....	.....	Oct. 18	Oct. 16 (14 years)
INSECTS.													
Honey-Bee (*Apis mellifica*)	Mar. 14	Feb. 2	Feb. 12	Jan. 29	.....	.....	Mar. 14	.....	Jan. 29	.....	.....	.....	Feb. 2
Wasp (*Vespa vulgaris*)	.....	Apl. 25	May 7	Feb. 20	.....	.....	Mar. 21	Feb. 14	Mar. 19	Mar. 22	.....	.....	Apl. 8
Small White Butterfly (*Pieris rapæ*)	.....	May 1	May 4	.....	.....	Apl. 15	Apl. 6	Apl. 12	Apl. 29	May 6	.....	.....	Apl. 5
Orange-Tip Butterfly (*Anthocaris cardamines*)	May 26	.....	May 20	.....	.....	May 9	May 17	May 12	May 10	May 19	June 1	.....	May 9
Meadow-Brown Butterfly (*Epinephele janira*)	.....	.....	.....	.....	.....	June 25	June 13	.....	.....	May 5	.....	.....	May 22

The Summer.

June proved warm, and July exceptionally warm, but during the whole of August low temperatures prevailed. The fall of rain was very unequally distributed over the quarter, June being very wet, and also the last week in August, but during the intervening eight weeks the rainfall continued very light. At Berkhamsted the sun shone on an average for 6¼ hours a day, or for about ten minutes a day longer than is seasonable.

After the long period of dry weather in May the heavy rainfall during the first fortnight in June was greatly welcomed, but unfortunately came too late to save the hay crop, which proved almost everywhere rather light. The dry period which followed, however, enabled it to be harvested in excellent condition. All the other farm crops were benefited, and more particularly the roots and the grass. This rain also came to the timely aid of the late-sown spring corn. Owing in the first instance to the May drought, and the hot and dry weather in July, the young roots made a bad start, and had in many cases to be resown. The July heat hastened the corn harvest, and as after cutting began the weather continued fine and warm, a great deal of corn was gathered in under the most favourable circumstances. But those farmers who were unable to bring their harvest operations to a conclusion until late in that month encountered some interruptions through the wet weather which followed.

Good progress was made by vegetation in the garden during June, which was a warm, wet, and sunless month, but further growth was afterwards checked by the July drought, and the scorching weather which accompanied it. The flower garden was particularly gay throughout a great part of the season, but during the dry period referred to the vegetables in the kitchen garden made but little advance.

At Harefield the hay harvest began on June 21st. Our observer at Odsey reports that his wheat was first cut on July 28th, and that on August 10th, or less than a fortnight afterwards, the whole crop had been carried. Mr. Graveson, writing from Hertford, states that several of the rarer plants mentioned in the 'Flora of Hertfordshire,' which had not been seen by him before, were found last year in flower in that district. Mr. J. J. Willis, in some very interesting notes on the farm crops at Rothamsted which he has kindly sent me, states that only two out of the twenty-four plots of grass there yielded an over average crop of hay, and that the wheat was little affected by the July drought except as regards the straw, which was much shorter than usual. That the crop was a good one is shown by the fact that on the permanently unmanured plot which has now grown wheat for sixty-two years, the yield was eighteen bushels per acre, as against an average for the previous sixty years of thirteen bushels per acre. The first ear of wheat at Rothamsted was out of its sheath on June 11th, which is one

day earlier than its average date in the previous thirteen years. At Berkhamsted there was no measurable percolation through my bare soil gauge during the six weeks ending August 27th, which shows how dry the soil must have become during the latter part of that period.

Taking the county as a whole, the plants on the list which flower during the summer months in most cases came into blossom within a day or two of their average dates. The dog-rose was one day early, the black knapweed two days late, the harebell eight days late, and the greater bindweed two days early.

The Autumn.

This was the coldest autumn for eighteen years. The three months were all cold, and in October the mean temperature was exceptionally low. The rainfall proved light during September and October, but was rather in excess of the average during November. Taking the season as a whole, there was an average deficiency in bright sunshine at Berkhamsted of about ten minutes a day.

Throughout September and October the ploughing of arable land proceeded with but little hindrance from rain; indeed, the ground was at times, if anything, too dry. The winter cereals were in most cases well sown, but the seed-bed afforded them was not so perfect as in the previous autumn, for the land was at first rather too dry, and, on the other hand, from the end of October until the close of the season too wet. The root crops greatly improved during this autumn, and by the end of November had made surprising growth, considering how unfavourable most of the late spring and summer weather had been for them. The grass in the pastures likewise improved, and remained green and fresh during the whole of the autumn.

All went well in the garden until a cold period set in towards the end of October, when on eleven successive nights there occurred frosts of more or less exceptional severity for the time of year. On the coldest of these nights, that preceding the 17th, dahlias and other tender plants were cut to the ground. During this season the vegetables in the kitchen garden, owing to the cold weather, made only moderate growth; there, however, remained at the close of it a fairly good supply for winter use.

Our new observer at St. Albans reports that in October mangolds and swedes were, as a rule, unusually large, and that on the 17th of that month nasturtiums, heliotropes, and other tender plants were killed by frost.

Mr. Willis's remarks as regards the root crops at Rothamsted are of special interest, owing to their singularly varied career in 1905. He says: The early-sown mangolds did the best, as they became established before the unfavourable weather arrived, whereas it was the late-sown swedes which proved the most satisfactory. The early-sown swedes, on the other hand, became

mildewed, and in many cases had to be resown. The heavy rains of June gave all the root crops a good start, but they afterwards received a considerable check owing to the July drought. Then, towards the end of August and throughout September, came the climatic influences just suited to their requirements, and it was truly astonishing how rapidly both mangolds and swedes responded to them. This late but rapid growth, however, brought about late maturing, so that although the individual roots were large, they were less satisfactorily ripened than usual.

According to the returns of farm produce in Hertfordshire, published by the Board of Agriculture, the yield of wheat was 4½ per cent. above the average for the previous ten years, barley 2 per cent. above, oats 3 per cent. above, beans 16 per cent. above, peas 11 per cent. above, turnips 16 per cent. above, mangolds 14 per cent. above, and hay (clover, etc.) 8 per cent. above, while potatoes were an average crop, and hay (permanent pasture) 1 per cent. below the average for the same ten years. It will thus be seen that of all the farm crops there was only one in which the yield was in any way below average.

The fruit crops, according to the returns sent in to the 'Gardeners' Chronicle,' on the other hand, were, taking the county as a whole, remarkably poor, the yield of apples and plums being very small, those of pears and strawberries rather better but still under average, while the crops of raspberries, currants, and gooseberries were, if anything, rather in excess of their respective averages.

The last plant on the list, the ivy, taking the county as a whole, came into flower eight days in advance of its usual time.

The swallow took its departure four days later than its mean date for the previous fourteen years.

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XIII.

HERTFORDSHIRE MAPS: A DESCRIPTIVE CATALOGUE OF THE MAPS OF THE COUNTY, 1579 TO 1900.

By HERBERT GEORGE FORDHAM.

PART III: 1794–1900 -(*continued*).

(See Vol. XII, Part 5, p. 208.)

***1842. Lewis, Samuel.** 9 × 6¾. Scale, about 5 miles = 1 inch. Drawn on steel by R. Creighton.

A further reprint of the county map of 1831. The additions as to polling-places, etc., found in the map of 1833 are omitted in this impression. On the map itself the boundaries of the poor law unions are shown, and the "Railroad from Birmingham to London", and the "London and Cambridge Railway" (the latter with the branch to Hertford) are drawn-in. Under the title is a "Reference to the Unions", in two columns, and the star-indicator thus displaced is re-drawn in the left-hand bottom corner of the map.

From 'A Topographical Dictionary of England.' By Samuel Lewis. Fifth edition. 4 vols., London, 1842, 4to.

***1843. Parliamentary Gazetteer of England and Wales.** 9⅞ × 7 1/16. Scale, about 4½ miles = 1 inch. Engraved on steel by Gray & Son.

A further reprint of the Herts map of 1833, as amended in 1840, and with the addition of the railway "From London . . . . to Newmarket."

From 'The Parliamentary Gazetteer of England and Wales.' 4 vols., London, Edinburgh, and Glasgow, 1843, 8vo. This edition is described on the title-page as "Compiled with a special reference to the lines of Railroad and Canal communication, as existing in 1840–43."

***1843 (c). Smith, Charles.** 20 5/16 × 17¾. Scale, 2 miles = 1⅝ inch. Engraved by Jones & Smith, Pentonville.

A further reprint of the county map first printed in 1801, with the alterations on the 1827 impression, the parliamentary divisions being shown, and the London and Birmingham railway inserted. In the title, after "Divided into Hundreds," is added: "and the Parliamentary Divisions," and it is: "Corrected to 1843."

No doubt this map is from a reprint of Smith's large county atlas, but I have only seen the individual map described above.

***1843 (c). Dugdale, Thomas.** 9¼ × 6¾. Scale, 5¼ miles = 1 inch. Engraved by J. Roper [1805].

Another issue of the Hertfordshire map of the 'Beauties of England and Wales', without imprints, but with the following additions:—At foot of Explanation, "Polling Places"; on the

map, indications of polling-places, a new road between Chipping Barnet and South Mimms, the "London and Birmingham Railway," and the "North Eastern Railway."

From the 'Curiosities of Great Britain. England and Wales Delineated, Historical, Entertaining and Commercial.' "By Thomas Dugdale, Antiquarian, assisted by William Burnett, Civil Engineer." London, no date, 8vo. This work is in two volumes of letterpress, one of plates, and one of maps. Many of the maps bear the imprint: "Drawn and Engraved for Dugdale's England and Wales Delineated" (wanting in that of Herts), and those of Derbyshire and Gloucestershire are dated 1843. The population cited in the text is that of 1831. It is to be noted that the London and Birmingham railway was opened in 1838, and the North-Eastern (or Great Eastern), as far as Broxbourne, in 1840.

1845. Kelly, W., & Co. $10\frac{3}{4} \times 8\frac{1}{8}$. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

A rather faintly-printed map of Herts, in a plain, ruled border, giving the usual details, with railways and stations, and an asterisk denoting money-order offices. In the left-hand top corner: "Post-Office Map of Hertfordshire. 1845", and, below: "Scale of (6) Miles", and the signs denoting polling-places and "Post Office Money Order Towns", and a thin vertical line with a star at the upper end and a cross line as indicator of the points of the compass. In the right-hand bottom corner, the number of square miles and inhabitants in the county, the names of the hundreds, and the number of members returned to Parliament by the county, and the boroughs of Hertford and St. Albans. Below the margin, in the centre: "Kelly & Co. Post Office Directory Offices, 19 and 20 Old Boswell Court, Temple Bar", and, on the right: "Drawn and Engraved by B. R. Davies, 16 George Str. Euston Squ."

From the 'Post Office Directory of the Six Home Counties, viz., Essex, Herts, Kent, Middlesex, Surrey and Sussex. With Maps engraved expressly for the work.' London, no date (but Preface dated July, 1845), 8vo. This is the earliest issue of this Directory, which, under titles slightly varying from time to time, was re-issued in 1852, 1855, 1859, 1862, 1867, 1871, and 1874 (with the above map of Herts), and in 1878, 1882, 1886, 1890, 1894, and 1898, with larger maps. The small map was also reprinted in an atlas of county maps in 1860 by the same firm of publishers.

1845 (?). Fisher, Son & Co. $13\frac{1}{4} \times 10\frac{1}{16}\frac{1}{4}$. Scale, about $3\frac{1}{4}$ miles = 1 inch. Engraved by E. P. Becker & Co.

A map of Hertfordshire in a double-ruled border, marked with degrees and minutes of latitude and longitude, and showing the usual details, but within the county area only, the main roads, however, being carried to the margin of the map, where indications are given of their directions. The Great Eastern

Railway, the North-Western main line, and the branch to Aylesbury are inserted. The miles are marked on the main roads, and the hills are heavily shaded. In the left-hand top corner, in ornamental capitals: "Hertfordshire." Below the title is a "scale of Miles" (and "Furlongs"), and again below, particulars of the members of parliament returned, and signs for rectories, vicarages, perpetual curacies, and chapels of ease, as used on the map. In the right-hand bottom corner a Table of Places of Election and Polling, and, below the margin, at foot, on the left hand: "Drawn by E. P. Becker & C°, Albion Road, Holloway."; in the centre: "Fisher, Son & C° London & Paris"; and, on the right: "Engraved on Steel by 'The Omnigraph.' E. P. Becker & C° Patentees."

From 'Fisher's County Atlas of England and Wales.' London, no date, fol. This atlas has letterpress descriptive matter inserted between the maps. The earlier pages are headed 'Gilbert's County Atlas', but afterwards 'Fisher's County Atlas of England and Wales.' Some of the maps are engraved by J. Archer. The frontispiece map of England and Wales is dated, at foot, 1845, and the figures of the census of 1841 are inserted in the text.

1845 (?). Ramble, Reuben (pseudonym). $4\frac{1}{4} \times 2\frac{3}{4}$. Scale, about 12 miles = 1 inch.

A small map of the county engraved in the middle of a 4to page, the margin of which is filled with views and rural scenes. At the top, St. Alban's Abbey and a loaded wagon; on the left, Waltham Cross; on the right, a man threshing in a barn with a flail; and, at the bottom, scenes of mowing corn and picking fruit. The map itself is in a double-lined border, with degrees and minutes of latitude and longitude, and shows the county boundary, the main roads, the London and North Western railway, the rivers, towns, villages, and parks. In the top left-hand corner is the title: "Hertfordsh", and, below: "Railways . . . . ." In the right-hand bottom corner is a "Scale of Miles" (10), and an arrow-head indicator of the north above it. In the margin at foot, on the left: "Long. West", and on the right: "Long. East." The meridian seems to be that of London.

From 'Reuben Ramble's Travels through the Counties of England.' London, no date, 4to. This work is described in the preface as a "Juvenile Introduction to the English Counties." It contains 40 maps, with a letterpress description of two pages to each map, in large type. The frontispiece, title-page, and the designs round the maps are coloured. A few railways are shown on the maps. The population of Herts is given as 157,000 (i.e., for the year 1841). The same work, with the same maps and designs, was published in five sections, with separate titles on cardboard covers. That of the second section is 'Reuben Ramble's Travels in the Southern Counties of England', with,

below, a sketch-map of the area described, viz.:—Surrey, Kent, Suffolk, Bucks, Middlesex, Sussex, Essex, and Herts. Both works are published by Darton & Clark, 58, Holborn Hill.

***1845. Lewis, Samuel.** 9 × 6¼ Scale, about 5 miles = 1 inch. Drawn on steel by R. Creighton.

An impression of the county map unaltered from that of 1842.

From 'A Topographical Dictionary of England.' By Samuel Lewis. 6th ed., 4 vols., London, 1845, 4to.

*** 1845. Hall, Sidney.** 9⅛ × 7⅞. Scale, 4½ miles = 1 inch. [Engraved October, 1830.]

Hall's map of Herts again reprinted, with the following alterations from the impression of 1836:—the insertion of the "London and Cambridge Rl. Rd", with branch line from Broxborne to Hertford, and the addition at the foot of the Reference to the Hundreds, etc., of "Railway Stations marked thus . . ."

From 'A Travelling County Atlas: with all the Coach and Rail Roads accurately laid down and coloured, and carefully corrected to the present time.' London, 1845, 8vo. The only copy of this atlas I have seen is one in the Library of the British Museum, in a case for the pocket.

A map of Hertfordshire of this series of a yet later date occurs in the collection of Mr. Greg. It may be of about 1850, as the Great Northern main line, with branch to Cambridge, is inserted by hand in colour, but it is, of course, also possible that these insertions were made on a single copy of the map of 1845, and that there was no later re-issue of the county maps.

***1846. Walker, John and Charles.** 15¼ × 12½. Scale, 1 mile = ¼ inch.

A reprint from the map of 1835, altered only as follows:—population of 1841 substituted for that of the previous census; Watford, Hitchin, Stevenage, and Gt. Berkhampstead added to the list of Polling Places; the "Aylesbury Railroad", and the "Railroad from London to Cambridge" (with branch to Hertford) inserted, and the date in the imprint "1846."

This map may have appeared in an edition of the 'British Atlas', but the only copy I have seen is a single map in the collection of Mr. Greg.

*** 1846 (c). Smith, Charles.** 20⅝ × 17¼. Scale, 2 miles = ⅛ inch. Engraved by Jones & Smith, Pentonville.

Apparently the last reprint from Smith's plate of 1801. It is "Corrected to 1846", and has added upon the map of 1843 (c) the Great Eastern main line with the branch to Hertford, and the boundaries (in blue) of the boroughs of Hertford and St. Albans. The "Explanation" is extended by the insertion of references by signs to the "Boundaries of Hundreds; Principal Places of County Elections; Boroughs to return two members; Boroughs to return one member", and "Polling Places."

This map also is from an atlas, but I have not been able to find a copy.

1847. Johnson, Thomas. $8\frac{1}{16} \times 6\frac{15}{16}$. Scale, $5\frac{1}{2}$ miles = 1 inch.

A coarsely-drawn map of Hertfordshire, showing the county and hundred boundaries, the rivers and canals, the main and some cross roads, towns, villages, and parks, with the London and North Western and Great Eastern main lines, and their stations. The border is ornamented, and shows the degrees and minutes of latitude and longitude in circles cut out of the ornamentation. In a long panel in the left-hand top corner: "Hertfordshire." Below the panel: "Railway Stations marked thus"; and, again below, a scale of 8 "English Miles." In the right-hand bottom corner is a rather heavy shield bearing the arms of the borough of St. Albans, with the legend "Arms of St. Albans."

From 'Johnson's Atlas of England.' Manchester, 1847, 8vo.

This collection contains 42 maps, each of which has one local coat of arms engraved in the margin.

1848. Reynolds, James. $6\frac{7}{8} \times 9\frac{15}{16}$. Scale, $7\frac{1}{2}$ miles = 1 inch. Drawn and engraved by John Elmslie.

A map of Middlesex, Hertfordshire, Bedfordshire, and Buckinghamshire, including the whole of Hertfordshire except so much as lies east of the longitude of Greenwich, which small portion is included in a map of Essex in the same series. The map is in a plain-ruled, double border, cut by the boundaries of the counties at a good many points. It gives the railways (with stations), roads, rivers, towns, villages, and parks. In the left-hand top corner is an indication of the railways, open, and constructing, and a scale of twelve "English Miles", and, in the right-hand top corner, a slightly-drawn arrow-head indicator of the north. The title, in the left-hand bottom corner, runs: "Middlesex, Hertfordshire, Bedfordshire, and Buckinghamshire." Below the margin of the map, on the left: "Drawn and Engraved by John Elmslie"; in the centre: "Published by J. Reynolds, 174 Strand", and, on the right, the figure 2.

From 'Reynolds's Travelling Atlas of England.' London, 1848, 8vo. It contains 32 maps of individual counties and groups of counties.

(Reprinted with alterations in 1860, geologically coloured, about 1864 (1) plain and (2) geologically coloured, and in 1889, geologically coloured.)

1848 (?). Collins, Henry George. $7\frac{15}{16} \times 5\frac{1}{16}$. Scale, $7\frac{1}{2}$ miles = 1 inch.

A small map of the county in a plain, ruled border, showing the rivers, canals, main roads, towns, villages, and parks, with the London and Birmingham, and London and Cambridge Railways, and their branches to Aylesbury and Hertford respectively. In the left-hand top corner, in a long, narrow panel, is the title "Hertfordshire", in plain capital letters, and below it a "Scale

of (10) Miles." In the right-hand bottom corner is a star-indicator of the cardinal points, and, at the foot, below the margin: "London. Published for the Proprietors by H. G. Collins, 22, Paternoster Row."

From 'The Travelling Atlas, of England and Wales, with all the Railways and Coachroads, : . . .' London, no date, 8vo. The above date is that given in the British Museum Library Catalogue.

This collection contains 39 maps of the English counties, 3 of the ridings of Yorkshire, one of North and one of South Wales, and a folding map of England in 4 sheets.

(Reprinted in 1852. The same atlas was re-issued in 1868, with the maps re-engraved.)

***1848 (?). Walker, John and Charles.** 15⅛ × 12½. Scale, 1 mile = ⅛ inch.

The county map of 1835, with the hunt districts coming into the county area shown, namely:—the Cambridgeshire, the Puckeridge, Mr. Brand's, and Baron Rothschild's. The places of the meets are shown by a large black dot. The "London and York Railway" (Great Northern) is inserted.

Under the title is added: "Places of the Meeting of Fox-hounds", and, above the top right-hand corner: "N°. 16." The date following the imprint is erased.

From 'Hobson's Fox-Hunting Atlas.' This atlas, published by J. & C. Walker, 9, Castle Street, Holborn, contains 42 maps. London, no date, fol.

***1849. Lewis, Samuel.** 9 × 6¼. Scale, about 5 miles = 1 inch. Drawn on steel by R. Creighton.

A further (and apparently the last) print of the map of Herts first issued in 1831, and subsequently amended, unaltered from the impressions of 1842 and 1845.

From 'A Topographical Dictionary of England.' By Samuel Lewis. 7th ed., 4 vols., London, 1849, 4to.

***1850 (c). Dugdale, Thomas.** 9⅜ × 7½. Scale, 5 miles = 1 inch. Engraved by J. Archer.

A reprint of the map of Herts noted under the date 1840 (c), with the railways shown as follows:—London and North Western, Great Northern, and Northern and Eastern, with branch to Hertford, and a line called the "Oxford and Cambridge Railᵞ.", extending from Dunstable through Lilley, Offley, Hitchin, and Baldock, to beyond Royston. The imprint at foot in the centre which appears on the previous issue of this map is here omitted.

From the 'Curiosities of Great Britain. England and Wales Delineated, Historical, Entertaining and Commercial Alphabetically arranged.' 4 vols., including one of maps, London, no date, 8vo. It is described as "By Thomas Dugdale, Antiquarian, assisted by William Burnett, Civil Engineer", and

has the same text (including the population according to the census of 1831) as is found in the edition of this work noted under date 1843. A copy in the British Museum has the maps and engravings bound in with the letterpress.

1852. Clarke, Benjamin. 16⅜ × 13¼. Scale, about 3 miles = 1 inch.

A map of Herts in a ruled border, ornamented at the angles and along part of the sides, etc., by scroll-work.

It shows all the usual details, rather coarsely engraved, and the railways, with a few hills slightly indicated in the north of the county. The railways and main roads are carried beyond the county boundary up to the border of the map. The Great Northern Railway and its branches are shown as lines for which Acts have been obtained. The title, in the left-hand top corner, in a band: "Hertfordshire", has above it a scroll containing the words: "The British Gazetteer." Below it: "3 For the County 3 | 2 For each, Two Boroughs 4 | Total number of Members 7." On the right of the title is a star-indicator of the north. In the right-hand bottom corner is a "Reference to the Hundreds", and, below it, an "Explanation", giving a great many particulars. Below the map: "London. Published for the Proprietors, by H. G. Collins, 22, Paternoster Row."

From 'The British Gazetteer, Political, Commercial, Ecclesiastical, and Historical; . . . Illustrated by a full set of County Maps, with All the Railways accurately laid down; Forming at once an Iron Road-Book and County Atlas.' 3 vols., London, 1852, 8vo. This work is published "for the Proprietors" by H. G. Collins. The maps are published separately in a large 4to atlas without title or date. It contains 41 maps.

There is a copy of this map in Mr. Andrews' collection in which the words "The British Gazetteer" are wanting in the title. Another, and later, copy, in the Lewis Evans collection, has a plain ruled border, the "Explanation" re-written, additions to the railways, and some other trifling amendments. I have not been able to give it a date.

1852 (c). Collins, Henry George. 2⅛ × 3 1/16. Scale, about 40 miles = 1 inch.

A map in a narrow, double-ruled border, extending north to Spalding, south to Croydon, west to Buckingham, and east to Bury St. Edmunds. It is engraved with hill-shading throughout, with the rivers, towns, and a few villages shown, but no roads. The railways are a principal feature, those in Herts being the London and North Western main line, with a branch to Aylesbury, the Great Northern Railway, and the Hitchin and Cambridge branch, and the Great Eastern main line and branch to Hertford. At the top of the map, above the margin: "Bedford. Hertfordshire. Cambridgeshire. Huntingdon."

From 'Collins' Pocket Ordnance Railway Atlas of Great Britain.' London, no date, 24mo. It is published by "H. G.

Collins, 22, Paternoster Row, London", and consists, besides title-pages, explanations, and lists of maps, of 32 sectional maps of England and Wales, and 14 of Scotland, the whole engraved on cards, on one side only, and bound in a case for the pocket.

The above date is that given, doubtfully, in the Catalogue of the Library of the British Museum.

*** 1852. Kelly, W., & Co.** 10¾ × 8¼. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

A reprint of the map of Herts of 1845, redated in the title 1852, and with some additions to the railways, and to the signs in use on the map.

From the 'Post Office Directory of the Six Home Counties.' London, no date (but Preface dated November, 1851), 8vo. This is the second issue of the Directory.

*** 1852. Orr, William S., & Co.** 7 3/16 × 5 11/16. Scale, 7½ miles = 1 inch.

A rather faint impression of the Herts map published by H. G. Collins in 1848 (?), with the insertion of the Great Northern main line and the branch from Hitchin to Cambridge, and of additional indications of direction where the railways leave the county boundaries. The imprint at foot is altered to: "London: (Published for the Proprietors) by W. S. Orr & C°, 2, Amen Corner, Paternoster Row."

From 'The Travelling Atlas, of England and Wales.' London, no date, 4to.

*** 1852 (c). Dix, Thomas.** 17 7/16 × 14. Scale, about 3 miles = 1 inch.

A further reprint of the map of the county of 1816, with the following railways shown by thick black lines: "London and Birmingham," "London and York," "Northern and Eastern," with branches from Watford to St. Albans, Hertford to Luton, to Dunstable, and Leighton Buzzard, and from Hitchin to Cambridge, and Broxbourne to Ware and Hertford. At the foot of the "Explanation" is added: "Railways", and the imprint is: "London. John Darton & C°: 58 Holborn Hill."

The above date is very doubtful, resting only on the existence on the map of the indications of railways. The only copy I have seen is in the Lewis Evans collection.

1854. Craven & Co. 16½ × 13¼. Scale, about 3 miles = 1 inch.

A plainly-drawn and not very well printed map of Herts, with the usual details, and showing the railways. The above measurements are to the border, there being outside the border at the corners and at the top of the map large ornamental scrolls. The title is also at the top of the map: "Craven & C°'s Directory Map of Hertfordshire." In the left-hand top corner is an "Explanation", and an indication of the cardinal points, and

in the right-hand bottom corner a "Reference to the Hundreds", and a scale of miles. There are no indications of latitude and longitude on this map.

From 'Craven & Co.'s Commercial Directory of Bedfordshire and Hertfordshire, containing an alphabetical list of the Nobility, Gentry, Merchants, Professions, Trades, etc. . . . . List of London Bankers, Receipt and Bill Stamps, etc. Price of the Work — To Subscribers, with Maps, 10*s.* 6*d.* Nottingham: Printed for, and Published by, The Proprietors, 1854.' 8vo.

*** 1854. Slater, Isaac.** 14 × 8⅛. Scale, 4½ miles = 1 inch. Engraved by Pigot & Son.

A further reprint of James Pigot & Co.'s map of Herts, as described under dates 1834 (c) and 1838, with the insertion of the following railway:—London and North Western—a branch to Aylesbury, and from Aylesbury continued at a right angle towards the N.N.W., and a branch from Watford to St. Albans, and continued to Luton, Dunstable, and Totternhoe; Great Northern — the main line, and branches from Hatfield to St. Albans, Welwyn to Hertford, and Hitchin to Royston; Great Eastern—a branch to Hertford. In the imprints at foot, in the centre, "I. Slater" is substituted for "Pigot & Co., 59", and, on the right, the same is inserted in lieu of "Pigot & Son."

From 'I. Slater's New British Atlas.' London, no date, fol. This is a reprint of Pigot & Co.'s atlas of 1838, but the population according to the census of 1851 is inserted, and the frontispiece map is dated 1854.

*** 1855. Kelly & Co.** 10¾ × 8⅝. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

A reprint of the map of 1845, as amended in 1852, but re-dated 1855, and with slight alterations in the railways. The number of inhabitants in the county is also amended, and the reference to the members of parliament for St. Albans, as well as the engraver's name, are omitted.

From the 'Post Office Directory of Essex, Herts, Kent, Middlesex, Surrey and Sussex' (the 3rd ed. of the Directory of the Six Home Counties), London, 1855, 8vo.

*** 1855 (?). Cruchley, George Frederick.** 21¼ × 18¼. Scale, 2¼ miles = 1 inch. Engraved by John Cary.

An unaltered impression of Cary's large map of 1801–1828, except that Cary's imprint at the foot of the map has been erased, and in place of Cary's title is now: "Cruchley's Railway Map of Hertford, Shewing all the Railways and names of Stations, also the Telegraph Lines and Stations, Improved from the Ordnance Surveys. London, Published by G. F. Cruchley, Map Seller and Globe Maker, 81, Fleet Street", with, below it, an "Explanation" of the characters and signs used on the map. The following railways are shown on this impression:—London and North Western, with the Aylesbury branch; Great Northern,

with branches to Bedford and Cambridge; Great Eastern, and branches to Enfield and Hertford. The above date is that given for this map in the British Museum Catalogue.

*** 1858 (?). Collins, Henry George.** 9¼ × 6¼. Scale, 5½ miles = 1 inch. Engraved by J. Roper [1805].

A very faint and worn impression of the map of Herts in the 'Beauties of England' of 1808, as altered in successive issues. It has no imprint, but retains the number 18.

From 'Collins' Railway and Pedestrian Atlas of England.' It contains 41 maps. London, no date, 8vo. The publishers are "Darton & C°., 58, Holborn Hill." The above date is that given in the Catalogue of the Library of the British Museum.

*** 1859. Kelly & Co.** 10¾ × 8¼. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

A re-issue of the map of 1845 and subsequent dates, as amended in 1855, but redated 1859, and with some slight further alterations and additions in the railways.

From the 'Post Office Directory of Essex, Herts, Kent, Middlesex, Surrey and Sussex' (the 4th ed.). London, 1859, 8vo.

1860. Weekly Dispatch. 16¾ × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

A map of Herts, showing full details within the county boundary, with the main roads, railways, and principal towns to the margin. The margin itself is plain, with the degrees and minutes of latitude and longitude marked on it. Printed on thin paper. In the left-hand top corner is a small design of the upper part of a globe, with a scroll upon which appears: "The Dispatch Atlas", and, above it, a flying figure of Mercury. Below this design: "Hertfordshire. By B. R. Davies, from the Ordnance Survey. The County of Hertfordshire consists of 391,141 Acres, and returns 5 Members to Parliament; viz. 3 for the County and 2 for the Borough of Hertford. Boundary of County . . . ." In the right-hand bottom corner a scale of 8 "English Miles, 69.1 = 1 Degree", and, on the right-hand side, near the margin, a very slightly-drawn arrow-head indicator of the north. At the foot, below margin, on the left: "Weekly Dispatch Atlas, 139 Fleet Str.", in the centre: "Day & Son Lith^rs. to The Queen", and, on the right: "Engraved by B. R. Davies, 16 George Str. Euston Squ." Outside the border of the map, at the right-hand top corner, is an embossed scroll, with raised pattern and lettering: "Supplement to the Weekly Dispatch of Sunday April 8^th. 1860", from which this map is taken.

(Reprinted by Cassell, Petter & Galpin, in their 'British Atlas', about 1864, and by G. W. Bacon, and his successors, in various atlases (with the plate slightly enlarged by additions at the margin), in 1876 (c), 1884 (c), 1885 (c), 1889 (c), 1891, 1895, 1897, and 1899, and probably at some intermediate dates.)

1860 (?). Hall, Sidney. $15\frac{11}{16} \times 12\frac{3}{16}$. Scale, about $2\frac{3}{4}$ miles = 1 inch.

An exact, enlarged, reproduction of Hall's map of the county of 1830 in its 1845 state, with the addition of the number 17 in the margin in the top right-hand corner, and of the following railways:—a branch of the London and North Western Railway from Watford to St. Albans; the main Great Northern line, described as the "London and York Railᵞ.", with branches from Hitchin to Bedford and to Cambridge; and a line continued direct from the Hertford branch of the Great Eastern Railway to the Great Northern main line near Welwyn. The imprint at foot is: "London, Published by Chapman & Hall, 193 Piccadilly."

From a large folio atlas, containing 49 maps, entitled 'The English Counties. By Sidney Hall. With all the railroads accurately laid down, and the boundaries coloured.' London, no date, imp. fol. This atlas is catalogued in the British Museum, doubtfully, as of 1860, but it may have been somewhat earlier. I have only seen one copy.

*** 1860. Reynolds, James.** $6\frac{7}{8} \times 9\frac{4}{16}$. Scale, $7\frac{1}{2}$ miles = 1 inch. Drawn and engraved by John Elmslie.

A reprint of the map of Middlesex, Herts, Beds, and Bucks of 1848, with some slight additions to the railways, and coloured geologically, but otherwise unaltered.

From 'Reynolds's Geological Atlas of Great Britain.' London, 1860, 8vo.

*** 1860. Kelly & Co.** $10\frac{3}{4} \times 8\frac{1}{8}$. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

Another reprint of the map of the county of 1845, etc., as last previously republished in the Post Office Directory in 1859, with at foot, below border, on left: "Printed from Stone by C. F. Cheffins & Son London", in centre: "Kelly & Cº. Post Office Directory Offices, 19, 20 and 21 Old Boswell Court, Temple Bar", and, on right: "Drawn and Engraved by B. R. Davies." This map is not dated.

From 'The Post Office Directory Atlas of England and Wales,' published by Kelly & Cº. London, no date, large 4to. This is an atlas of county maps as "originally published with the Directories for the respective Counties", and "corrected to the present time, December, 1860."

*** 1860 (c). Dugdale, Thomas.** $9\frac{3}{8} \times 7\frac{1}{4}$. Scale, 5 miles = 1 inch. Engraved by J. Archer.

A further reprint of Archer's map of Herts as altered in 1850 (c), but the "Oxford and Cambridge Railway" erased from Hitchin westward, other branch railways added, and the polling places marked on the map.

From 'Dugdale's England and Wales Delineated.' 2 vols., London, 8vo. This issue was published in monthly parts at the price of 1*s.* each, and is ascribed to 1854–60 in the British

Museum Catalogue, the numbers bearing various date-marks in 1858 and 1860. The population of 1851 is inserted in the text.

*** 1862. Walker, John and Charles.** 15½ × 12½. Scale, 1 mile = ½ inch.

A further reprint of the map of Herts of 1835, retaining the original imprint, with the date erased. Statements as to population, etc., are altered from those in the issues last described, 1846, 1848 (?), but the plate appears to be otherwise the same.

From a folio atlas of county maps, of which the title runs:—"To Her Most Excellent Majesty Queen Victoria, and to Her Royal Highness the Duchess of Kent,* *This British Atlas*, Comprising separate maps of every County in England each Riding in Yorkshire and North and South Wales, ... is, with their gracious permission most respectfully Dedicated by their very humble and devoted Servants, J. & C. Walker." This is, no doubt, an impression of the original title-page of the atlas of about 1842. The atlas is published by Longman, Rees & Co., and J. & C. Walker, and is dated 1862. In the statistical and other tables bound with the maps the population of 1841 is retained, as is the case in the map of Herts of 1846.

*** 1862. Kelly & Co.** 10¾ × 8¼. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

A further reprint of the map of 1845, as amended in 1855 and 1859, and with some slight additions to the railways, and the correction up to date of the number of the inhabitants of the county. At foot, below margin, on the right: "Drawn and engraved by B. R. Davies." The map is redated 1862.

From the 'Post Office Directory of Essex, Herts, Middlesex, Kent, Surrey and Sussex,' the 5th ed., London, 1862, 8vo.

***1862 (?). Cruchley, George Frederick.** 3⅛ × 5. Scale, 10 miles = 1 inch. Engraved by John Cary.

A reprint from Cary's small plate of 1792, which has, however, been much altered. The names on the map are almost entirely re-written, now reading from east to west instead of from south to north on the map. The panel at foot is replaced by: "London, Published by G. F. Cruchley Map Seller and Globe Maker, 81 Fleet Street", and the panel and indicator of the north, etc., at the top of the map are omitted, and the title re-engraved in block letters. Cary's name is also erased, and the figure "16" is engraved at the corner to the right of the title. The isolated portion of the county in Bucks is also absent. "A Scale of Statute Miles" (10) is engraved in the S.W. corner of the map. Railways and stations are shown by black lines and dots, and the names are underlined. The above date is from the British Museum Catalogue, but a later impression from the same plate,

* The Duchess of Kent died March 15th, 1861. This title-page must have been engraved between 1837, the date of Queen Victoria's accession to the throne, and that of her marriage in 1840.

taken off for me by Messrs. Gall & Inglis, shows the addition of the Midland main line, and a number of branch lines to those drawn on the above map. There was, therefore, it seems, a re-issue during or before the year 1876, when the plates were acquired by the Edinburgh publishers (see 1875 *post*).

From 'Cruchley's Railroad Companion to England and Wales Shewing all the Railways and Stations with their Names, also The Turnpike Roads to all the Market and Borough Towns. Delineated on a series of 42, County Maps.' London, no date, 12mo. From the details on the map of Herts I should conjecture that this little atlas was issued somewhat earlier than 1862.

*** 1863. Cruchley, George Frederick.** $10\frac{4}{16} \times 8\frac{1}{4}$. Scale, about $4\frac{1}{2}$ miles = 1 inch. Engraved by John Cary.

A reprint of the map of Herts by Cary first issued in 1787, and re-engraved in 1793, from which latter plate this map is printed, with the following alterations:—The original title is completely erased, and in its place "Railway and Station Map of Hertfordshire with the names of the Stations" is inserted; the number "16" is added outside the top right-hand corner, and the following imprint is engraved below the map: "London. Published by G. F. Cruchley, Map-Seller and Globe Maker 81, Fleet Street"; the detached portion of the county lying south of Amersham is omitted; the railways inserted (shown by a thick black line with round black spots for the stations, and the names of stations underlined) are the London and North Western, with a branch from Cheddington towards Aylesbury, and branches to Rickmansworth and St. Albans, the Great Northern main line, with branches through Luton and Dunstable joining the North Western near the edge of the map, to Hertford, towards Bedford marked: "Midland Railʸ.," and to Cambridge, marked: "Grᵗ. Eastern Ry.," and the Great Eastern main line, with branches to Hertford and Buntingford. There are also projected railways, indicated by broken lines, towards the north and west from Rickmansworth, and one from the Great Northern main line to St. Albans.

From 'Cruchley's County Atlas of England and Wales.' London, 1863, 8vo. This collection contains the whole set of 46 county and other maps, as originally issued by Cary.

*** 1864 (c). Cassell, Petter & Galpin.** $16\frac{3}{4} \times 12$. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

A reprint of the map of Herts published by the 'Weekly Dispatch' in 1860, slightly altered by the addition of several sections of railway (*e.g.*, the Buntingford branch), the omission of the three lines of particulars below the title, for which a scale of "English Miles" is substituted, and of the embossed scroll at the right-hand top corner, the omission of the design above the title, of the indicator of the points of the compass, and of the imprints, etc., below the margin of the map, and the insertion

(filling the whole space in the right-hand bottom corner) of particulars of the area, population (census of 1861), marriages, births, and deaths (1861), physical geography, divisions, parliamentary representation, population of principal towns, and statistics of education and crime (1862) for the county. Outside the map at the right-hand bottom corner is the number "30", and below the map, at the same corner, the imprint: "London, Published by Cassell, Petter & Galpin, La Belle Sauvage Yard, Ludgate Hill, E.C."

From 'Cassell's Universal Atlas,' a series of about 260 folio maps issued in parts, 1864–66, according to the Catalogue of the British Museum Library. The Herts map occurs in a section bearing the sub-title 'Cassell's British Atlas,' London, no date, fol.

* **1864 (?). Reynolds, James.** $6\frac{1}{4} \times 9\frac{5}{16}$. Scale, $7\frac{1}{2}$ miles = 1 inch. Drawn and engraved by John Elmslie.

A reprint of the map of 1848, with the addition of some railways beyond those added in 1860, the border reduced to a single line, the imprints omitted, and the figure 2 inside instead of outside the right-hand bottom corner.

From the 'Portable Atlas of England and Wales; with Tourists' Guide.' London, no date, 8vo.

* **1864 (?). Reynolds, James.** $6\frac{1}{4} \times 9\frac{5}{16}$. Scale, $7\frac{1}{2}$ miles = 1 inch. Drawn and engraved by John Elmslie.

Another reprint of the map of 1848, as amended in the plain map of this date, coloured geologically, as in the issue of 1860.

From 'Reynolds's Geological Atlas of Great Britain.' "New Edition." London, no date, 8vo.

* **1864 (?). Smith & Son.** $20\frac{1}{8} \times 18\frac{1}{4}$. Scale, 2 miles = $1\frac{1}{8}$ inch.

A worn impression from Charles Smith's plate of 1801, from which it differs in some trifling erasures and additions, and slightly in its dimensions, and in the following alterations:—an isolated portion of the county lying in Bedfordshire between Stondon and Shefford is inserted, as well as these villages and some few others in adjoining counties; the title is re-written: "Map of Hertfordshire Shewing all the Railways and Stations and the Parliamentary Divisions London. Smith & Son, 63 Charing Cross"; the "Explanation", in the right-hand bottom corner, is re-written and extended, including the statement that "3 Members are returned for the County", although both Hertford and St. Albans are indicated on the map itself as returning members to parliament. To the left of the "Explanation" is inserted a list of "Polling Places" in two columns; below the map: "London, Published by Smith & Son, 63 Charing Cross." Of the railways inserted the branches from the Great Eastern main line to Buntingford and that from Hitchin to Cambridge are shown as completed, and the Midland main line, and branches from Hatfield to St. Albans and St. Albans to Luton, and one from Rickmansworth to near

Chenies, are drawn in dotted lines, as projected or in course of construction only.

This is an individual map of which I have seen one copy only, that in the British Museum Library. In the catalogue the date is given as above, but it must be a very doubtful one.

*** 1867. Kelly & Co.** 10¾ × 8⅝. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

The map of 1845 again reprinted from the issue of 1862, with additions to the railways, a correction of the population, the omission of the reference to money-order offices, and the date 1867.

From 'The Post Office Directory of Essex, Herts, Middlesex, Kent, Surrey and Sussex,' the 6th ed., London, 1866, 8vo. All the maps are dated 1867, and the preface, October, 1866. It was probably, therefore, issued early in the former year.

1868. Hamilton, Nicholas Esterhazy Stephen Armytage. 12 × 9⅝. Scale, about 4 miles = 1 inch.

A map showing the railways, roads, and canals, as well as the towns, villages, hamlets, houses, parks, and the hills in the north of the county, upon which also the tumuli are marked to the west of Royston. The border is in the usual double-ruled form, with the degrees and minutes of latitude and longitude marked upon it. The railways are indicated by a broken line, and, with the rivers and a few roads and principal towns, are shown to the margin of the map. In the left-hand top corner, in capitals: "Hertfordshire." Below the title a scale of (8) "English Miles", and: "Railways." At the foot, below the border, in the centre: "London: James S. Virtue", and, at the right-hand corner: "W. Hughes."

From 'The National Gazetteer of Great Britain and Ireland.' London, 1868, 3 vols., large 8vo. The map of Herts is in vol. ii, at p. 252.

(Reprinted about 1873, in 'A New County Atlas.')

1868. Heywood, John. 7½ × 5¾. Scale, 6½ miles = 1 inch.

A re-engraved and slightly altered and larger map of Herts, following that published in Collin's 'Travelling Atlas' of 1848 and 1852 (*ante*, pp. 93 and 96). It has the same details as the earlier maps, with the addition of the Great Northern Railway and its branches to Cambridge, St. Albans, and Luton, and the Buntingford branch of the Great Eastern. The border is shaded, and the figure 19 is engraved at the bottom right-hand corner.

From 'The Travelling Atlas, of England and Wales,' described on the outer cover as 'John Heywood's County Atlas of England and Wales.' Manchester, no date, 4to.

*** 1868 (?). Cruchley, George Frederick.** 10⅝ × 8¼. Scale, about 4½ miles = 1 inch. Engraved by John Cary.

Another edition of Cruchley's map of 1863. In this issue the title is "Hertfordshire" only, in thick black letters; an additional projected railway is shown by a broken line from Colney Hatch to Hertford, and the Midland main line is inserted; a projected line is, similarly, shown to Chipping Barnet, and one from the North Western line at Watford running in a north-westerly direction. The Great Northern branch to St. Albans is shown, as completed, by a hard line, and the following names are changed:—that of the branch from Dunstable to the North Western line from "G^{t}. Northern R^{y}." to "Nth. Western R^{y}.", and that of the Cambridge branch from Hitchin to "G^{t}. Northern R^{y}." Cruchley's imprint at the foot of the map is erased.

From an undated issue of 'Cruchley's County Atlas' ascribed to 1868 (?) in the British Museum Library Catalogue. London, 8vo.

1870. Cussans, John Edwin. 16½ × 13¼. Scale, 2½ miles = 1 inch.

A clear and well-printed map of Herts, with the usual details. In the left-hand top corner, in large, shaded, ornamental letters: "Hertfordshire", with, below: "For Cussans's History of Hertfordshire, 1869", and, again below, scale of "English Miles", and explanations of the signs used on the map.

From Cussans's 'History of Hertfordshire,' 3 vols., London, 1870–73, 1874–78, and 1879–81, folio. The map forms the frontispiece to vol. i, and was issued originally with part 1, it seems, in 1870; each title-page bears the double date:—Vol. i, 1870–73; vol. ii, 1874–78; vol. iii, 1879–1881, covering in each case the dates of issue of the parts the volume contains.

*** 1870. Walker, John and Charles.** 15½ × 12½. Scale, 1 mile = ⅛ inch.

Walker's map of the county again reprinted, with the imprint: "London Published by J. & C. Walker 9 Castle Street Holborn" substituted for that of "Longman, Orme, Rees & C^{o}," which appeared on the original plate and on impressions from it up to 1862. The titles of the railways are modernised, and the following railways added:—the branch from St. Margarets to Buntingford on the Great Eastern, those to Luton and St. Albans from the Great Northern, and that from Watford to Rickmansworth on the London and North Western Railway, as well as the Midland main line. Otherwise the impression is unaltered from that of the atlas of 1862.

From the 'British Atlas', with the same title-page as the edition of 1862, but with the date altered to 1870. London, 1870, fol.

*** 1871. Kelly & Co.** 10¾ × 8⅝. Scale, about 5 miles = 1 inch. Engraved by B. R. Davies.

This reprint of the maps of Herts, 1845–1867, differs from that of the last date by the omission of the reference to

polling places, alterations in the railways, the date 1871, and the addition below the margin on the left-hand side, of "J. M. Johnson & Sons, Printers, 3, Castle Street, Holborn and 56 Hatton Garden, London."

From 'The Post Office Directory of the Six Home Counties,' 7th ed., London, 1870, 8vo. The Preface is dated "November, 1870."

1872. Hertfordshire Quarter Sessions. 37 × 25. Scale, 1 mile = ¾ inch.

A sketch-map of the county with the same details as are given in the smaller map described under date 1887 (*post*, p. 121). In the left-hand top corner: "Hertfordshire." In the right-hand top corner a large star-indicator of the cardinal points, and in the bottom corner on the same side of the map a scale of 10 miles.

This map appears to have been prepared for the use of the Court of Quarter Sessions, in connection with the discussion of the proposals for abolishing the separate administrative and judicial systems which until 1875 existed in the Liberty of St. Alban on the one hand, and the remainder of the county area on the other, resulting in the passing of the County of Hertford and Liberty of St. Alban Act, 1874, which came into operation on the 1st January, 1875, amalgamating the two jurisdictions, and setting up the arrangement for original and adjourned Quarter Sessions in Hertford and St. Albans which now subsist.

*** 1872 (c). Walker, John and Charles.** 15¼ × 12½. Scale, 1 mile = ⅜ inch.

Another impression of the Herts map of 1835 and subsequent dates, apparently unaltered from that of the atlas of 1870, but issued in folding cover for the pocket, and the population of 1871 inserted in the cover and on the map. The imprint appears to have been replaced in this impression by the word "London" only.

A folding map, lettered on the cover, 'Walker's Hertfordshire.' It is published by J. & C. Walker, 37, Castle Street, Holborn. London, no date, 12mo.

***1872 (?). Cruchley, George Frederick.** 10$\frac{5}{16}$ × 8¼. Scale, about 4½ miles = 1 inch. Engraved by John Cary.

A reprint of the map in Cruchley's atlas, with the details unaltered from those found in the previous (1868?) issue.

From another undated issue of 'Cruchley's County Atlas', in which the title-pages of four separate parts are bound up in the British Museum copy. The title of each part runs: 'Cruchley's New Pocket Companion, or, Handmaid to Bradshaw and all other Railway Time Tables for England and Wales, in Four Divisions.' London, no date, 8vo.

1873. Faunthorpe, J. P. 8 × 6. Scale, 6 miles = 1 inch.

A map of Herts showing the rivers, canals, the principal and some cross-roads, and railways (the latter being a prominent feature), and towns, villages, hills, and parks, in a plain, double-ruled border, marked with the degrees and minutes of latitude and longitude. Above the top of the map is: "Philips' Educational Series of County Maps", and below the border, at the foot: "George Philip & Son. London and Liverpool." In the left-hand top corner of the map: "The County of Hertford", with, below, a scale of 8 "English Miles", and, again below, indications of Railways, Roads, and Canals.

From 'The Geography of Hertfordshire, for use in Schools', by the Rev. J. P. Faunthorpe, M.A., F.R.G.S. This is a small volume of 32 pp., of which the preface is dated "Nov. 1872. J.P.F." London, 1873, 8vo.

(Reprinted in 'Philips' Handy Atlas of the Counties of England' of this date, and also in editions of 1876 and 1895.)

*** 1873. Philip, George, & Son.** 8 × 6. Scale, 6 miles = 1 inch.

A reprint of the map of Herts in 'The Geography of Hertfordshire' of this date, with the omission of the title printed above the map in that publication, and the addition of the number 16 at the right-hand bottom corner.

From 'Philips' Handy Atlas of the Counties of England.' "By John Bartholomew, F.R.G.S." London, 1873, small 8vo.

*** 1873 (?). Hughes, William.** 12 × 9⅝. Scale, about 4 miles = 1 inch.

A reprint of the map in 'The National Gazetteer' of 1868, indexed under Hamilton, with the imprint altered to: "London: Virtue & Co", and the Midland main line, the Buntingford branch on the Great Eastern, and the Hatfield and St. Albans branch on the Great Northern added.

From 'A New County Atlas of Great Britain and Ireland.' London, no date, fol. It contains 68 maps. A copy in the Cambridge University Library is stamped with the date, "15 Aug. 73", and this is the only specimen of the atlas I have seen.

*** 1874. Kelly & Co.** 10¾ × 8¼. Scale, about 5 miles = 1 inch. Engraved by F. Bryer (?).

Apparently a slightly altered, and the last, reprint of Davies' map of Herts of 1845, but it may have been re-engraved, as Bryer's name replaces that of Davies on the map. The alterations from the original design and details are very slight. This map is dated 1874, and at foot, on the left side, is: "J. M. Johnson & Sons, Litho, 56, Hatton Garden, London", in the centre: "Kelly & Co. Post Office Directory Offices, 51 Great Queen Street, London", and on the right: "Engraved by F. Bryer."

From 'The Post Office Directory of the Six Home Counties,' the 8th ed., London, 1874, 8vo.

1874 (c). County of Hertford Divisions. 20 × 15. Scale, about 2¼ miles = 1 inch.

An outline map, showing the railways, and a few towns and other details, and specially by distinct colouring the areas of the "proposed" Hertford and St. Albans Divisions. It has a plain border of three ruled lines, drawn with an indented curve at the angles. In the left-hand top corner: "Hertfordshire." In the left-hand bottom corner a "Note" as to the colouring, etc., and, in the right-hand top corner, a large, shaded indicator of the points of the compass, with, in the bottom corner on the same side of the map, a scale of miles. Printed across the map on the eastern side: "Proposed Hertford Division", and, on the western side: "Proposed 'Liberty of St. Alban' Division."

I have no clue to the date of this map beyond the fact that the County of Hertford and Liberty of St. Alban Act, 1874 (37 & 38 Vict., c. 45), must have involved considerable previous discussion, based, no doubt, on special maps, and that the one noted here may have been such a map; but it may, of course, have been prepared earlier than the above date.

1874 (?). Speed, John. 16¼ × 12¼. Scale, about 3 miles = 1 inch.

A fac-simile reproduction, on a smaller scale, of Jodocus Hondius' map of Herts of 1610. It contains all the details of the original, with the same imprint. At the foot, outside the border, is: "Re-printed and published by Kelly & Co., and presented to the subscribers to the Post Office Directory of Herts. Price to non-subscribers, one shilling."

I have not been able to discover with which issue of the Directory this map was presented, but it seems probable that it may have been that of 1874, viz.: 'The Post Office Directory of the Six Home Counties,' (8th edition). London, 1874, 8vo.

1875. Philip, George, & Son. 16⅛ × 13⅜. Scale, 2½ miles = 1 inch.

A well-filled map, on the basis of the 1″ Ordnance Survey map, with the details carried to the border of the county, with the principal roads, the railways (by dotted lines), and some towns shown beyond, in a double-ruled border, the map itself being ruled up into rectangular spaces by lines of 10′ longitude and 5′ latitude, the spaces lettered along the top and bottom margins A to G, and numbered at the sides 1 to 6. It shows the rivers, canals, roads, railways, towns, villages, hamlets, houses, parks, and hills. Above the border, at the top right-hand corner, the number 16, and at the foot, in the centre: "George Philip & Son London & Liverpool." The title, in the left-hand top corner of the map, is: "Hertfordshire," in large, ornamental, shaded capitals, and below: "By Edwd. Weller, F.R.G.S.", a scale of 8 "English Miles", indications of the railways, canals,

roads, and railways constructing, and again below: "The Colouring represents the Parliamentary Boroughs." In this map the county area is coloured a dull green with a narrow pink border line, except the area of the parliamentary borough of Hertford, which is coloured pink.

From 'Philips' Atlas of the Counties of England, reduced from the Ordnance Survey.' "By Edward Weller, F.R.G.S. New Edition. With a complete Consulting Index, By John Bartholomew, F.R.G.S." London and Liverpool, 1875, large 4to. The collection contains 48 maps, one of the Channel Islands being added in the edition of 1885.

(This map is reprinted, with trifling alterations, in a supplement to the 'Pictorial World,' Nov. 3rd, 1877; in another edition of the 'Atlas' 1885, and at the same time in pocket editions of the individual maps; in 1897, in 'The Way About Hertfordshire'; and in the 'Herts Almanac' for 1898, 1899, 1900, and subsequent years.)

*** 1875. Cruchley, George Frederick.** $10\frac{5}{16} \times 8\frac{1}{4}$. Scale, about $4\frac{1}{2}$ miles = 1 inch. Engraved by John Cary.

Another, and, no doubt, the last re-issue of Cruchley's map from Cary's plate. It is slightly altered from the last impression. A double line is ruled under the title, and the isolated portion of Herts, as well as Cruchley's imprint (as in the copy of 1863), are replaced. The railways are brought up to date, a branch from Bishop's Stortford being added on the Great Eastern main line, the projected branch lines from Rickmansworth, as well as that from Enfield to Hertford, and the line drawn in a north-westerly direction from Watford being erased.

From the last issue by Cruchley of his 'County Atlas.' London, 1875, 8vo.

(The plates used in this atlas, as well as the stock of maps already printed from them, were sold to Messrs. Gall & Inglis, of Edinburgh, in 1876 or 1877.)

*** 1875 (c). Cruchley, George Frederick.** $21\frac{1}{4} \times 18\frac{1}{4}$. Scale, $2\frac{1}{4}$ miles = 1 inch. Engraved by John Cary.

Cary's large map of Herts, re-engraved by Cruchley in his 'County Atlas of England', and also published separately, passed, no doubt, through a series of editions. I have a copy of about 1885, as published by Messrs. Gall & Inglis, of Edinburgh; the additions of the railways upon the plate appear, most of them, to date back to at least as early as 1875. For a note of the differences between this impression and those published by Cary himself, see 1885 (c), Gall & Inglis (p. 119 *post*).

From 'Cruchley's County Atlas of England', which contained 42 maps, and may have been first issued under this title as early as 1832. This map was also sold "coloured, in a cover, 6d."

*** 1875 (c). Cruchley, George Frederick.** $3\frac{11}{16} \times 5$. Scale, 10 miles = 1 inch. Engraved by John Cary.

An impression of the map of Herts issued in 'Cruchley's Railroad Companion' (1862?), from the plate now in the possession of Messrs. Gall & Inglis, shows additions of various railways as compared with the map in the above work—additions which bring the map into line with the larger map in Cruchley's 'County Atlas' of 1875.

It may, therefore, be assumed that there was a reprint of the 'Railroad Companion' about 1875.

1876. Pryor, Alfred Reginald. 9¾ × 7¾. Scale, 6 miles = 1 inch. Lithographed by Vincent Brooks, Day & Son.

A sketch-map with plain margin, showing the boundaries of the river-basins, the rivers and streams, and a few towns. In the left-hand top corner: "A map of Hertfordshire Showing the Districts into which it is proposed to divide the County for the illustration of its Botanical Geography. R. A. (*sic*) Pryor, B.A., F.L.S. 1875." Along the margin, in the left-hand bottom corner, is a scale of (20) miles, and, in the right-hand bottom corner, a double column of the names of the river-basins distinguished by numbers corresponding with those on the map. Outside the margin, at the top right-hand corner: "Trans. Watford Nat. Hist. Soc., Vol. I. Pl. I." Below the bottom right-hand corner: "Vincent Brooks, Day & Son, Lith."

From the 'Transactions of the Watford Natural History Society and Hertfordshire Field Club,' Vol. I. Watford and London, 1878, 8vo. This map illustrates a paper 'On the Botanical Work of the Past Season.' By A. R. Pryor.* Read Nov. 11th, 1875, and published March, 1876.

*** 1876. Philip, George, & Son.** 8 × 6. Scale, 6 miles = 1 inch.

A reprint of the map of Herts in the 'Handy Atlas' of 1873, unaltered, except that the number 16 is transposed to the top right-hand corner, and the map itself is ruled-up into rectangular spaces lettered A to G along the top and bottom margins, and numbered 1 to 4 at the sides.

From 'Philips' Handy Atlas of the Counties of England.' "New and revised edition." London, 1876, small 8vo.

*** 1876 (c). Bacon, George Washington.** 16½ × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

A further reprint from the plate used by the 'Weekly Dispatch' in 1860, with amendments. The alterations on the plate are as follows:—in place of ornament above title "Bacon's Map of" is inserted, and the letters of the title itself, formerly open, are filled up with a pattern; in the number of members of Parliament returned 4, is substituted for 5, and 1 for 2; below the words "Boundary of County" in the earlier map is inserted an

* Described as "R. A. Pryor," under which reversed order of initials Mr. Pryor was in the habit of publishing to avoid confusion with his father. A short memoir appears in the Introduction to the 'Flora of Hertfordshire' (1887), at pp. xliv–xlv (b. 1839, d. 1881).

indication of the designs used on the map to show "Railways and Stations", "Canals", "Roads", and the "Boundary of Borough." There is also, placed in the right-hand bottom corner, above the scale of miles, a "Note" as to the engraving of railway stations on the map, the stations being inserted and indicated by a small circle. The additions to the railways themselves are:—Watford to Rickmansworth, the Midland main line, Great Northern branches from Hatfield to St. Albans and to Luton, and a branch to Enfield, and the Great Eastern branch to Buntingford. All the statistical information in the right-hand bottom corner in the 1864 impression is erased. The original details in this corner of the map and the indicator of the points of the compass are restored. At the right-hand top corner, outside the border, is the number "26", and below, at the foot, on the left-hand side, the imprint: "Bacon's Map Establishment, 127 Strand, London", these being in lieu of the original or subsequent marginal numbers and imprints.

From 'Bacon's New Quarto County Atlas.' London, no date, 4to. The date-stamp in the British Museum copy is "30 Aug. 1876." There are 55 maps of the counties of England and Wales in this collection.

1877. "Official" Guide to Hertfordshire. 17⅛ × 14¼. Scale, about 2¾ miles = 1 inch.

A lithographed map of the county copied, apparently, as to details, from a map dating from the end of the 18th century, with the railways and stations inserted. It is in a double-ruled border, showing the degrees and minutes of latitude and longitude, and gives all the usual full details. The title, in the left-hand top corner, is: "Official Map of Hertford", with, below, a view of "St. Alban's Abbey Church, as restored in 1877." In the bottom corner on the same side of the map is a star-indicator of the north, and on the right-hand side, in the top corner, a "Reference to the Hundreds", and, in the bottom corner, an "Explanation." Along the bottom are given particulars as to the members returned to parliament, and, in the centre, is a scale of nine miles.

From 'The "Official" County Map and Guide [to Hertfordshire], shewing its Railways, Telegraphs, Roads, Rivers, Canals, Market Towns and Days; with Geological, Archæological, Historical, Statistical, Descriptive, Parliamentary, and Postal County Information for Home reference, and for Travellers, Tourists, and Men of Business.' This is one of a series of small county guides published in 1877–8. London, no date, small 8vo. Some of the county maps have at foot: "W. J. Freeman, Steam-Litho. 2, Old Swan Lane Upper Thames St. E.C."

1877. Collins, William, Sons & Co. 6⅛ × 8. Scale, about 7 miles = 1 inch.

A map of Beds and Herts, showing the roads, rivers, and canals, with the railways, the towns, and a few villages and

parks, and the hills shaded. The details, except as to the railways and main roads, are not carried outside the area of the two counties. The border is a plain double line. In the right-hand top corner: "Bedfordshire and Hertfordshire", with, below, a scale of 10 "English Miles", and, again below, examples of the mode of indicating on the map the railways, canals, and roads. Above the top right-hand corner is the number "26", and at the foot, in the centre, the imprint: "William Collins, Sons & C°. London & Glasgow."

From the 'Atlas of England and Wales, containing Maps of all the Counties, Coloured into the Parliamentary Divisions.' London, no date, 8vo. The preface is dated May, 1877, and states that "The following Maps, with one exception, were designed in the first instance for a series of County Geographies, which have had an extended sale."

***1877. 'Pictorial World'** (Supplement). 16⅛ × 13⅜. Scale, 2½ miles = 1 inch. Engraved by George Philip & Son.

A map of Herts identical in details with Philip's map of 1875, but with the title erased, as well as the marginal number and the imprint at foot. Along the top of the map, in large, ornamental, gothic letters: "The 'Pictorial World' Map of Hertfordshire", and above, to the left-hand side: "Supplement to the Pictorial World, November 3rd, 1877." In this impression of the map the whole county area is coloured a bright green.

From 'The Pictorial World An Illustrated Weekly Newspaper.' The Supplement to No. 192, vol. viii, Saturday, November 3rd, 1877, consists of the map folded in the middle, with particulars of the county of Hertford (2 pp.) on the back.

1878. Kelly & Co. 15½ × 12½. Scale, about 3 miles = 1 inch.

A map of Herts on thin, white paper, with a single-line border, following closely in style and details the smaller map issued with the Post Office Directory, 1845–1874. In the left-hand top corner: "Hertfordshire, 1878", with, below, a scale of six miles, and, again below, an indicator of the points of the compass like that in the earlier maps. Below the margin, in the centre: "Kelly & C°. Post Office Directory Offices, 51, Great Queen Street, London."

From 'The Post Office Directory of the Six Home Counties,' the 9th ed., and the last in this form. London, 1878, 8vo.

1878 (?). Bacon, George Washington. 24 × 17. Scale, 2 miles = 1 inch. Engraved by B. R. Davies.

A well-filled map, with all the usual details following the 1-inch Ordnance Survey map, hill-shading, the main roads and railways, together with some of the principal towns, shown up to the border of the map.

The border is plain-ruled, showing degrees and minutes of latitude and longitude. It is broken at the top in two places, part of the parish of Ashwell being carried through it, and the

district round Royston being shown up to the outer line. It is also broken, partially, on the west side at Saffron Walden, and to the south of that town. All modern railways, with stations, are shown by black lines and dots, the latter not being always correctly placed (e.g. Ashwell, which is shown about a mile to the west of its actual position). A broken line is also drawn on the map through Enfield to Hertford, to indicate a projected railway. In the left-hand top corner, the title is: "Bacon's Map of Hertfordshire. By B. R. Davies, from the Ordnance Survey", and, below: "The County of Hertfordshire consists of 391,141 Acres, and returns 4 Members to Parliament; viz. 3 for the County and 1 for the Borough of Hertford." Again below, an explanation of the signs used for the boundary of the county, the railways and stations, the canals, and the roads. In the right-hand bottom corner is a scale of (6) "English Miles, 69·1 = 1 Degree." Below the map, in the centre: "London, G. W. Bacon & C°. 127, Strand." This is probably an impression from a plate engraved much earlier than the date given above, but I have not been able to identify any such issue.

To fold in cover. On cover 'Bacon's New Tourist's Map of Hertford from the Ordnance Survey, with the Names of Every Railway Station.' London, G. W. Bacon & Co.

(Reprinted in 1885 (c), and re-engraved in 1896 (c).)

1880. Simson & Co. 22⅝ × 20. Scale, 2 miles = 1 inch. A map full of details extending to the margin, and showing the railways (with stations), main roads (with the miles marked on them), cross-roads, rivers and canals, with the towns, villages, hamlets, houses, parks, hills (shaded, and with the height above the sea-level given in a few cases), and woods. The details are, substantially, those given in the 1-inch Ordnance Survey map, but the names of places differ in some instances. The boundary of the county itself is indicated by a thick, black line. The map is set in a plain, wide, double-lined border, with the degrees and minutes of latitude and longitude marked on it. This is frequently broken along the top and bottom (only) by indications of the directions of the main roads. Outside the margin, at the top of the map, in the right-hand corner, is a "Scale of (14) English Miles", and, at the bottom corner on the same side: "Simson & C°., Printers and Bookbinders, Hertford."

From 'A Guide to Hertfordshire, with a History and Description of the various Towns and Villages, and objects of interest in the County. By an Old Inhabitant' [Mr. Young Crawley]. Hertford, 1880, 8vo. This map was also sold separately in a cover, with the title: 'A Map of Hertfordshire and Portions of the surrounding Counties.' "Price One Shilling. Hertford. Simson & C°." It was reprinted, with some additions, in 1886.

1880. Encyclopædia Britannica. 9¼ × 6½. Scale, 5 miles = 1 inch. Lithographed by J. Bartholomew, Edinburgh.

Shows the county area with the railways (with stations), roads, rivers, canals, towns, villages, and hamlets, and the parks, and hills, in a plain, double-lined border. At the top, outside margin: "Vol. XI", "Hertford", and: "Plate XV." At the foot, in centre, below the margin: "Encyclopædia Britannica, ninth edition", and, on the right-hand side: "J. Bartholomew Edin^{r}." In the right-hand bottom corner a scale of (7) miles.

From the 9th edition of the '*Encyclopædia Britannica*,' 24 vols., and Index, Edinburgh, 1875–1889, 4to, in Vol. XI, Plate XV, illustrating the article '*County of Hertford*,' at pp. 771, 772. Edinburgh, 1880, 4to.

1881. Hopkinson, John. 9⅛ × 7⅛. Scale, 5 miles = 1 inch.

A sketch-map with plain margin, and with lines drawn across map showing 5′ and 10′ of latitude and longitude respectively, rivers and canals in blue ink, and a few towns, and the rainfall stations and boundaries of the river basins in the county are shown. In the left-hand top corner: "Map of Hertfordshire Showing its River Basins and the Position of its Rainfall Stations, 1879–80. [Rainfall Stations shown thus: ●]", and, below, a "Scale of (10) Miles." In the right-hand bottom corner is a table of the "River Basins," in columns, corresponding with roman numerals (i–xvii) on the map. Outside the margin, at the top right-hand corner: "Trans. Herts. Nat. Hist. Soc., Vol. I, Pl. III," and, at the left-hand bottom corner: "J. Hopkinson, del. 1880."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club,' Vol. I, London, Watford, and Hertford, 1882, 8vo. The map illustrates the 'Report on the Rainfall in Hertfordshire in 1879.' By John Hopkinson, F.L.S., F.M.S. Read 20th April, 1880, and published March, 1881.

1881. Hopkinson, John. (In text in 8vo page,) about 2¾ × 2¼. Scale, 15 miles = 1 inch.

Title at top: "Outline-Map of Hertfordshire, showing Phenological Stations and Places at or near to which Observers are required." The map shows the boundary of the county and the places referred to in the title. In the left-hand top corner is a "Scale of (10) Miles," and below the map: "Phenological Stations ●. Other Places ○."

In the middle of an 8vo page (257) of the text of a 'Report on Phenological Observations in Hertfordshire in 1880.' By John Hopkinson, F.L.S., F.M.S. Read 19th April, 1881, and published in December of the same year, in the 'Transactions of the Hertfordshire Natural History Society and Field Club,' Vol. I, London, etc., 1882, 8vo.

*** 1881 (c). Walker, John and Charles.** 15½ × 12½. Scale, 1 mile = ⅛ inch.

A 'Fox Hunting Map of Hertfordshire', with the districts named as follows:—The Cambridgeshire, the Puckeridge, the Hertfordshire, Baron Rothschild, and the Old Berkley. The

names of the places at which meets were held are underlined. All modern railways are inserted on the plate as originally engraved in 1835, and used for the Fox Hunting Map published in Hobson's Atlas (1848?). In addition to the number at the right-hand top corner, "No. 16" is engraved outside the margin at the right-hand bottom corner. The imprint is now: "London, Published by J. & C. Walker 37 Furnival Street, Holborn", in lieu of that of Longman & Co.

A folding map, lettered on the cover 'Fox Hunting Map of Hertfordshire.' London, 12mo.

1882. Kelly & Co. 38 × 25. Scale, 1⅓ miles = 1 inch. Engraved by F. Bryer.

The first issue of a large and well-filled map of Herts, following the Ordnance Survey 1-inch map, in substitution for the small map previously published with Kelly's Directory. It has a plain-ruled border. The principal roads and railways, and a few towns, are shown outside the borders of the county, the details being, otherwise, drawn only within the county itself. In the left-hand top corner, in large, ornamental letters: "Hertfordshire", with, below, a "Scale of (10) Miles." A small ornamental indicator of the north, "Explanatory Notes", and a list of the hundreds are engraved in the right-hand bottom corner. At foot, in the centre, is the imprint: "London — Kelly & C°. Post Office Directory Office, 51 G^t. Queen Street, W.C.", and, on the right: "Engraved by F. Bryer, 19 Craven S^t. Strand, London."

From 'Kelly's Directory of the Six Home Counties. Volume I. Essex, Hertfordshire, and Middlesex.' London, 1882, 8vo. This is the first edition of this Directory with the three counties in a separate volume.

(This map is also published, with the county boundary and a few parks coloured, folded in 8vo, with title on cover: 'Post Office Directory Map of Herts', and it appears re-issued, with the Directory, in 1886, 1890, 1894, and 1898.)

1883. Elsden, James Vincent. 6 × 4½. Scale, 10 miles = 1 inch.

Shows the boundaries of the county, the rivers, railways, and a few towns and villages, and the superficial geology of the county by various forms of shading. Plain line margin. In the left-hand top corner: "Map of Herts Shewing the Superficial Geology." In the right-hand bottom corner an "Index" of the geological formations shown on the map. Outside the margin, at the top, on the right-hand side: "Trans. Herts. Nat. Hist. Soc., Vol. II, Pl. II."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club', Vol. II. London, etc., 1884, 8vo. This map illustrates 'The Agricultural Geology of Hertfordshire.' By J. Vincent Elsden, B.Sc., F.C.S. Read 19th Dec., 1882, and published June, 1883.

(Reprinted in 1887.)

1883. Elsden, James Vincent. 6 × 4½. Scale, 10 miles = 1 inch.

A map of Herts showing the boundaries of the county, the rivers, railways, and a few towns and villages, and the soils indicated by various shadings and patterns. It has a plain line margin. In the left-hand top corner: "Agricultural Map of Hertfordshire from a survey by Mr. G. A. Deane", and, in the right-hand bottom corner, an "Index" of the soils as indicated on the map. Outside the margin, at the top, is: "Trans. Herts. Nat. Hist. Soc., Vol. II, Pl. III."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club', Vol. II. London, etc., 1884, 8vo. The map is one of the illustrations of a paper on 'The Agricultural Geology of Hertfordshire.' By J. Vincent Elsden, B.Sc., F.C.S. Read 19th Dec., 1882, and published June, 1883.

(Reprinted in 1887.)

*** 1883. Harrison, E., & Co.** 21¼ × 18⅞. Scale, 2¼ miles = 1 inch. Engraved by John Cary.

A further reprint of Cary's map of Herts, as issued by Cruchley, with the following alterations:—The title now reads: "Cruchley's County Map of Hertford Showing all the Railways and names of Stations, also the Turnpike Roads, Villages, Gentlemen's Seats Etc. Etc. Improved from the Ordnance Surveys: London: Published by Gall & Inglis, 25, Paternoster Square. Edinburgh: Bernard Terrace"; the "Explanation" below the title is omitted, and it is re-engraved in the right-hand bottom corner, with a scale of miles below it also re-engraved somewhat to the right of the place of the original scale, and without the original shaded panel. The star-indicator found in the right-hand bottom corner in Cary's impressions from this plate and in those of Cruchley up to 1855 (?) is wanting. The detached portion of Herts lying within the county of Bucks still remains, as on the original plate. All the modern railways are inserted, with the stations, and various slight alterations are made in the names of places, by re-writing and omissions where the old names interfere with the railway lines. The map is surrounded, outside the border, by large-type advertisements.

From 'The "Finger Post" Bicycle Road Guide', one of a series of "separate maps of all the Counties of England and North and South Wales", folding in small 8vo for the pocket, published by E. Harrison & Co., 259, Oxford Street, London. It is described on the cover as 'Harrison's "Finger Post" Bicycle Road Guide and County Map of Hertford.' London, 1883. The date is fixed by advertisements, and the British Museum date-mark: "19 Ju. 83."

1884. Letts, Son & Co., Limited. 15⅛ × 12¾. Scale, about 2¾ miles = 1 inch.

A map of Herts with the usual full details, as taken from the

Ordnance Survey maps, with the hills shaded and extending to the border of the county, the main roads, railways, and towns being shown up to the margin of the map. The hundreds are distinguished by numbers, and a few altitudes of the highest hills are inserted. There are various signs printed on the map in colours referring to the table of explanations, including one for dangerous hills, and three red rings printed on the map in a line across the centre, indicating the number of members of Parliament returned for the county. The map has a double-ruled border, with the degrees and minutes of latitude and longitude marked on it, and is ruled-up into eight-mile squares, lettered in the margin, at top and bottom, A to E, and, at the side, a to d. In the left-hand top corner, in a panel: "Hertford", and, below: "Letts, Son & C°. Limited", a scale of English furlongs and miles (6), and statistics of the population (for 1881), etc. In the bottom corner, on the same side of the map: "Railways constructing are shown by red dotted line", in the right-hand top corner is a star-indicator of the north, and, in the right-hand bottom corner, an "Explanation" of the signs used on the map, and a list of the hundreds. At foot, below the border, in bold letters: "Letts Son & C°. Limited, London Bridge, E.C." This map is numbered 17 on the back.

From 'Letts' Popular County Atlas.' London, 1884, fol. There are 47 maps in this atlas, and an index of names of places. (Reprinted in 1887.)

*** 1884. Urwick, William.** $9\frac{3}{8} \times 7\frac{11}{16}$. Scale, about $4\frac{1}{2}$ miles = 1 inch. Engraved on steel by Gray & Son.

The map of Herts originally printed in 1833 ('New and Comprehensive Gazetteer'), as altered in 1843 ('Parliamentary Gazetteer'), but with further amendments, as follows:—the view of St. Alban's Abbey, and both the imprints at foot erased, and the Great Northern main line, with the Cambridge branch as far as the boundary of the county, and the branch to Hertford of the Great Eastern Railway, inserted.

From 'Nonconformity in Herts.' By the Rev. William Urwick, M.A.* London, 1884, 8vo.

*** 1884 (c). Bacon, George Washington.** 18 × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

A reprint of Bacon's map of 1876 (c), with an addition of an inch on the left-hand side, and with the following other additions and differences:—The map is now ruled-up into $1\frac{3}{4}$ inch squares, numbered in the top and bottom margins, from left to right, 1–9, and lettered on both sides, from the top downwards, A–G; the title is re-written: "Hertfordshire reduced from the Ordnance Survey. Divided into 5 mile squares", with, below it, a scale of miles, the particulars of the signs used on the map, and the note

* Mr. Urwick died in Dublin on the 29th August, 1905, in his 80th year. He was at one time Pastor of the Congregational Church, St. Albans.

found in the right-hand bottom corner of the last-mentioned impression. There are no imprints, and the number "20" is engraved outside the right-hand top corner. A further addition of railways is made, viz.:—to High Wycombe and Aylesbury, and a branch from Hemel Hempstead to near Harpenden; and the Great Northern branch to Luton is partly re-drawn. A branch line to Edgware and another to Saffron Walden are also shown.

From the 'New Large-Scale Ordnance Atlas of the British Isles.' London, no date, fol. In the preface of this atlas the census of 1881 is referred to. The parliamentary divisions of 1885 are not shown, but the date-stamp in a copy in the Cambridge University Library is "9 Feb. 85", and 1884 seems a very probable date for its publication.

1885. Stanford, Edward. $6\frac{1}{8} \times 9\frac{5}{8}$. Scale, 8 miles = 1 inch.

A map of Hertfordshire and Middlesex, including also nearly the whole of Surrey. It is engraved with full details up to the margin, and shows the rivers, principal roads, and railways, and also the towns, villages, and a few parks. The parliamentary electoral divisions are shown by special colours, and their names are printed in red on the map. The border is a narrow double line, with a scale of miles marked in it on each side of the map from the bottom upwards, and at the top and bottom of the map from left to right. Above the top border is: "Middlesex and Hertford." At the foot of the map, in the centre: "London: Edward Stanford, 55 Charing Cross", and, on the right-hand side: "Stanfords Geographical Estab^{t}." At the right-hand bottom corner: "III. 6. 7.," and: "50." In the left-hand corner, also at the bottom, in the border itself: "Scale of Miles."

From 'Stanford's Parliamentary County Atlas and Handbook of England and Wales.' London, 1885, 8vo.

1885. Boundary Commissioners. $13\frac{1}{2} \times 9\frac{1}{4}$. Scale, 4 miles = 1 inch. Zincographed at the Ordnance Survey Office.

Map of Herts showing the proposed new parliamentary divisions of the county. It gives, in a double-ruled border, the county and adjacent districts, with the details extending to the margin of the map, and shows particularly the petty sessional divisions, and the four proposed parliamentary divisions, the latter defined by red boundary lines. The names of the parliamentary divisions are printed on the map in red, as are also the names of the petty sessional divisions, but in black. The principal roads, the rivers and railways, the towns and villages, and a few hamlets, houses, and parks are also shown, and meridian lines are ruled across the map. The title in the left-hand top corner, in a panel, is: "Hertfordshire New Divisions of County", and, below it, in another panel, is a "Scale—Four Miles to an Inch." In the right-hand bottom corner there are, similarly, two panels, the upper one

containing a "Reference" to the boundaries on the map, and the other the *fac-simile* signature: "R. Owen Jones Lt Colonel R.E." At the foot of the map, below the margin: "Zincographed at the Ordnance Survey Office, Southampton, 1885."

From the 'Report of the Boundary Commissioners for England and Wales, 1885', dated 10th. February, 1885. London, 1885, folio. It is in two parts, the map of Herts being in Part I (Counties).

This Commission was appointed in consequence of the passing of the Representation of the People Act, 1884, which extended the household and lodger franchise to counties, and in preparation for the Redistribution of Seats Act, 1885, which divided Hertfordshire into the four parliamentary divisions (Hitchin, Hertford, St. Albans, and Watford) recommended by the Commission.

(Reprinted in the same year in a Return made to Parliament.)

*** 1885. Redistribution of Seats Act, 1885, Return under the.** 13½ × 9½. Scale, 4 miles = 1 inch. Zincographed at the Ordnance Survey Office.

A reprint of the map published in the Boundary Commissioners' Report earlier in the year, with the following alterations:—The details outside the county boundaries are omitted, the colouring of the boundaries of the parliamentary divisions is slightly varied, and the names of the divisions are printed in black. The title and scale of miles are unaltered, but the "Reference" is transferred to the left-hand bottom corner, and the word "proposed", in the first line, is omitted. The signature, which remains in the original angle of the map, is slightly higher up than in the previous impression.

From a Return made to the House of Commons, showing for each county of England, Scotland, and Ireland, separately, the contents of each parliamentary division as constituted under the Redistribution of Seats Act, 1885. Ordered to be printed 8th July, 1885. London, 1885, folio.

*** 1885. Philip, George, & Son.** 8 × 6. Scale, 6 miles = 1 inch.

Another reprint of the county map of 1873, as amended in 1876, with some slight additions to the railways, and the insertion, below the title of: "The Colouring represents the Parliamentary Divisions, each returning 1 Member", these divisions being shown on the map.

From 'Philips' Handy Atlas of the Counties of England.' Bartholomew's name is omitted from the title-page of this edition. London, 1885, small 8vo.

*** 1885. Philip, George, & Son.** 16⅝ × 13¾. Scale, 2½ miles = 1 inch.

A further impression of the map of 1875, with the title, number, and imprint restored as in 1875, the line: "By Edwd. Weller, F.R.G.S.", being omitted, and the indication as to the colouring altered to read: "The Colouring represents the

Parliamentary Division of County, each returning 1 Member." The four new electoral divisions are separately coloured, and the parks are shown bright green.

From 'Philips' Atlas of the Counties of England, including Maps of North and South Wales, the Channel Islands, and the Isle of Man.' London and Liverpool, 1885, large 4to. This atlas contains 49 maps.

*** 1885 (c). Philip, George, & Son.** 16⅛ × 13⅜. Scale, 2½ miles = 1 inch.

A map of the county identical with that in Philip's atlas of this date, folding in cover for the pocket, being one of 'Philips' Popular Series of County Maps', with a title on cover: 'Philips' New Series of County Maps. Hertfordshire from the Ordnance Survey.' London and Liverpool, no date, 12mo.

*** 1885 (c). Philip, George, & Son.** 16⅛ × 13⅜. Scale, 2½ miles = 1 inch.

Another impression from the plate in the atlas of 1875, as used in the atlas of 1885, but wanting the number and the note as to parliamentary divisions, as well as the colouring. In lieu of the latter the roads are coloured dark brown, and various letters and signs are printed on them in bright red.

From 'Philips' Cyclists' Map of the County of Hertfordshire.' London and Liverpool, no date, 12mo. It folds for the pocket. The date-stamp in the British Museum is "21 May 1885."

*** 1885 (c). Gall & Inglis.** 21¼ × 18⅞. Scale, 2½ miles = 1 inch. Engraved by John Cary.

Cary's large map of the County, as altered by Cruchley (1832–1876), and further slightly amended by Messrs. Gall & Inglis, following their map catalogued under date 1883 (Harrison). It further differs from Cary's plate (1801–1828) in the following particulars:—The number "16" is added above the right-hand top corner; the detached portion of the county in Bucks, near Amersham, is omitted, and the names of the parliamentary divisions, as fixed in 1885, are engraved on the map. The title is again slightly varied from those of 1855 and 1883, and now reads: "Cruchley's Road and Railway Map of the County of Hertford . . . ."

This map, in a paper cover to fold, is one of a series of 42, which may, probably, also have been bound in an atlas. On the cover: "Cruchley's County of Hertford For Cyclists' Tourists' etc." It is published by Gall & Inglis, London and Edinburgh.

*** 1885 (c). Walker, John and Charles.** 15½ × 12½. Scale, 1 mile = ⅝ inch.

A further reprint, issued by Edward Stanford, of Walker's map of the county. It is from the same plate as the map of 1872 (c), with particulars of the population of 1881, and of the parliamentary representation under the Redistribution of Seats

Act, 1885, pasted in on a slip of paper, and the boundaries of the four new parliamentary divisions shown.

This is a folding map, retaining the lettering on the cover of 'Walker's Hertfordshire,' and the particulars inside the cover of the issue of 1872 (c). London, no date, 12mo.

*** 1885 (c). Bacon, G. W., & Co.** 24 × 17. Scale, 2 miles = 1 inch. Engraved by B. R. Davies.

Another impression of the map catalogued under the date 1878, unaltered, except that it shows the parliamentary divisions set up in 1885. In the title the line "By B. R. Davies, from the Ordnance Survey", is erased, and all the words after "Parliament", below, are also omitted, being replaced by a list of the parliamentary divisions showing their colouring on the map, and, below again, "Railways and Stations" only.

This map is, no doubt, one of a pocket series, but I have not seen any title.

*** 1885 (c). Bacon, George Washington.** 18 × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

An altered reprint of Davies' map, as published by the 'Weekly Dispatch' in 1860, lengthened by an inch on the west side. Outside the map at the top right-hand corner: "Hertford. 20." The title, in the left-hand top corner, re-written: "Hertfordshire Reduced from the Ordnance Survey Divided into 5 mile squares", with, below, the scale of miles as in the reprint of 1864 (c), and, below again, a list of the Parliamentary Divisions, with indications of the colours given them on the map, an example of the method for indicating the railways and stations, and a note as to the type used for distinguishing the latter. Besides the addition of matter to complete the map in its present dimensions on the left, many railways are added, the parliamentary divisions are shown, coloured, and the indicator of the points of the compass, erased in the impression of 1864, is restored, as well as the details in the right-hand bottom corner, in place of the descriptive particulars found in the edition of the latter date. There is no imprint, etc., below the map. Errors in the original remain, e.g., Ashwell Station is still shown a mile west of its actual position, and on a roadway which does not exist.

A pocket folding map, bound with descriptive text, and entitled on cover: 'Bacon's County Guide and Map of Hertford from the Ordnance Survey.' London, no date, 12mo.

(This map, in Bacon's series of pocket county guides, was reprinted, at short intervals up to the end of the century, and is still (1907) in use.)

*** 1886. Kelly & Co.** 38 × 25. Scale, 1½ miles = 1 inch.

A re-issue of the large map of 1882. The engraver's name which appeared below the right-hand bottom corner in the former edition is now replaced by: "Lithog. Kelly & Cº. London and Kingston."

From 'Kelly's Directory of Essex, Hertfordshire & Middlesex'. London, 1886, 8vo.

*** 1886. Simson & Co.** 22⅝ × 20. Scale, 2 miles = 1 inch.

A reprint of the map of 1880, published with Simson's Guide to Hertfordshire of that date. This re-issue is, however, on slightly thicker paper than that of the original map, from which it differs, also, in having the railways represented by a thick black line, and by some additional lines inserted. It has, besides, the minutes of latitude omitted in the margins, which are broken to show Saffron Walden, and Navestock on the east, and Drayton, Parslow, and Bierton on the west. A scale of 20 English miles is placed in the centre of the top of the map, instead of one of 14 miles on the right, and the imprint at the foot is also in the centre.

Issued in 1886 with 'A Guide to Hertfordshire,' in place of the map of the earlier date. Hertford, 1886, 8vo.

1887. Hertfordshire Quarter Sessions. 14⅝ × 11⅝. Scale, 3 miles = 1 inch. Lithographed by Robert J. Cook & Hammond.

A sketch-map with plain lined margin, showing railways, towns, villages, and a few hamlets and smaller places, and the names and boundaries of all parishes in the county. In the left-hand top corner: "Hertfordshire", and: "*Note.* The present (1887) County Boundary is shown by the heavy dotted line thus . . . . " In the right-hand top corner is an ornamental star-indicator of the north. In the right-hand bottom corner is a scale of (10) miles, and, below: "Rob^{t}. J. Cook & Hammond, Lith. Broadway, Westminster."

This map was prepared for the use of the Court of Quarter Sessions, in connection with the grouping of parishes into electoral divisions for the purpose of the election of county councillors, in view of the coming into force of the Local Government Act, 1888. (It was reprinted in 1888 and again in 1894.)

1887. Pryor, Alfred Reginald. 9 × 6¼. Scale, 5 miles = 1 inch. Lithographed by Edward Weller.

A sketch-map with plain margin, and with lines ruled across it showing 5′ and 10′ latitude and longitude respectively. The rivers and canals are shown in blue ink, and railways and boundaries in black. The towns and villages are also inserted, and the principal river-basins are distinguished by colour. In the left-hand top corner: "Map of Hertfordshire showing its River-Basins as adopted for the Botanical Districts." Below this title: "Scale of (10) Miles". In the right-hand bottom corner, in a column, a list of the "River-Basins", as distinguished by their colour. Outside the margin, at the foot of the map, on the left-hand side: "*J. Hopkinson, del.*", and, on the right: "Edw^{d}. Weller, *lith.*"

From 'A Flora of Hertfordshire', by the late Alfred Reginald Pryor, B.A., F.L.S., edited by Benjamin Daydon Jackson, Sec. L.S. London and Hertford, 1887, 8vo. The map is from the introduction on the geology, climate, etc., of the county, by John Hopkinson and the editor. (Reprinted in 1890.)

*** 1887. Pryor, Alfred Reginald.** 6 × 4¼. Scale, 10 miles = 1 inch.

A reprint of the map of Herts, showing the superficial geology, 'Trans. Herts. Nat. Hist. Soc.', Vol. II, Pl. II (1883), but wanting the imprint at the top.

From 'A Flora of Hertfordshire', by A. R. Pryor. London and Hertford, 1887, 8vo. This map is one of the illustrations in the introduction.

*** 1887. Pryor, Alfred Reginald.** 6 × 4¼. Scale, 10 miles = 1 inch.

A reprint of the Agricultural Map of Herts, 'Trans. Herts. Nat. Hist. Soc.', Vol. II, Pl. III (1883), but wanting the imprint at the top.

From 'A Flora of Hertfordshire,' by A. R. Pryor. London and Hertford, 1887, 8vo. It is another illustration to the part of the introduction by Mr. John Hopkinson.

*** 1887. Mason & Payne.** 15⅞ × 12¾. Scale, about 2¾ miles = 1 inch.

A reprint of Letts, Son & Co.'s map of 1884, with slight alterations as follows:—The word "London" added after the original name of the publishers below the title; the line as to railways in the left-hand bottom corner, and the three rings indicating the number of M.P.s returned omitted; some other trifling alterations in the signs used on the map, and the four parliamentary divisions, as established in 1885, shown, with their names printed in red.

From 'Letts' Popular County Atlas', the second edition, published by "Mason & Payne, proprietors and publishers of Letts's Atlases." London, 1887, fol.

1888. Ordnance Survey. About 14 × 13. Scale, 4 miles = 1 inch. Photozincographed at the Ordnance Survey Office.

A sketch-map, showing railroads, towns, parishes and their boundaries, and the sites of villages, with their names all printed in black ink; also the poor law unions, with their names and boundaries (so far as within the county) in red, the areas and boundaries of the boroughs in brown, and those of the urban sanitary districts in blue. The map has no border. The title, in the left-hand top corner, is: "Diagram of the Sanitary Districts in Hertfordshire, Shewing also Civil Parishes," and, below: "Scale of this Diagram 4 Miles to 1 Inch." In the bottom left-hand corner, in a rectangular panel, is a "Reference by letter to the small Parishes"; in the right-hand top corner is

a "Reference to Colours," and in the right-hand bottom corner, in a panel, a "Reference" to signs and indications on the map. At the foot: "Photozincographed at the Ordnance Survey Office, Southampton, 1888. Price 6d. All rights of reproduction reserved."

This is one of a series of diagrams of the counties in England and Wales, showing sanitary districts and unions, issued by the Ordnance Survey. There are 54 sheets in all (England, 42, including 3 for the Ridings of Yorkshire; Wales, 12).

1888. Boundary Commissioners. About 20 × 14¼. Scale, 4 miles = 1 inch. Photozincographed at the Ordnance Survey Office.

Sketch-map of the county, without border, the size, scale, and groundwork of the map itself being the same as in that last described. It shows the railways, parishes, sites of towns and villages, urban districts (shaded), poor law unions (names and boundaries red), and areas proposed to be transferred to and from the county (hatched red and green). In the right-hand top corner is: "To face page 155", and, in the left-hand top corner: "Local Government Boundaries Commission. Diagram of the Alterations Proposed By the Boundaries Commission, In the County of Hertford, Showing . . ." (followed by particulars of the signs, colours, and shadings used on the map), and, below: "Scale of the Diagram 4 Miles to 1 Inch", and, again, lower, lithographed signature: "Rob. Owen Jones." Towards the left-hand bottom corner, in a rectangular panel, a "Reference by letter to the Small Parishes", and below the map itself another rectangular panel containing "References." These panels, and the details in them, differ slightly from the similar matter on the map previously noted.

From the 'Report of the Boundary Commissioners of England and Wales, 1888.' Vol. I. London, 2 vols., large fol., no date, but: "Ordered to be printed 11th August 1888."

The Commission was appointed under the Local Government (Boundaries) Act, 1887, to consider the adjustment of county boundaries, etc., so that no union, borough, sanitary district, or parish should lie in more than one county. The report itself is dated 5th July, 1888.

*** 1888. Hertfordshire Quarter Sessions.** 14⅛ × 11⅛. Scale, 3 miles = 1 inch. Lithographed by Robert J. Cook & Hammond.

A reprint of the map of 1887, with the boundaries of the poor law unions coloured red, and the county electoral divisions coloured. In manuscript is added below the title "Hertfordshire", the words: "Local Government Act, 1888", and, below the *Note*: "Plan showing provisional arrangement of Electoral Districts, 14th Septr. 1888", and: "Unions shown thus."

This reprint was also prepared for the use of the Court of Quarter Sessions.

1889. Johnston, W. & A. K. $5\frac{1}{16} \times 5\frac{1}{16}$. Scale, 7 miles = 1 inch.

A map of Herts with one of Hunts below it on the same folio page. It has a double-line border broken at the top and on both sides, and is ruled up into four equal squares lettered in the top and bottom margin A., B., and at the sides a., b., and has all the usual details, with hills and parks shaded. In the top left-hand corner: "Herts", and a scale of 15 "English Miles."

From 'The Modern County Atlas of England & Wales,' Edinburgh and London, 1889, fol.

1889. Hopkinson, John. $5\frac{7}{8} \times 4\frac{5}{8}$. Scale, 8 miles = 1 inch. Lithographed by Edward Weller.

A sketch-map of the county, with a plain margin, divided by lines drawn across it at every 5′ and 10′ of latitude and longitude respectively, showing the county boundary, the rivers and canals, and the five climatological stations—Royston, Bennington, Berkhamsted, St. Albans, and New Barnet. In the left-hand top corner is: "Map of Hertfordshire, showing its Climatological Stations", a scale of (12) "English Miles", and "Natural Scale 1·506880." Below the margin, at the foot, on either side: "*J. Hopkinson, del. 1889*", and: "*E. Weller, lith.*", and, at the top, on the right-hand side: "Trans. Herts. Nat. Hist. Soc., Vol. V, Pl. III."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club', Vol. V. London and Hertford, 1890, 8vo. It illustrates a paper on the 'Climatological Observations taken in Hertfordshire in 1887.' By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc. Read 12th April, 1889, and published in December, 1889.

(Reprinted in 1893, 1896 (twice), and 1897.)

***1889. Reynolds, James.** $6\frac{5}{8} \times 9\frac{5}{16}$. Scale, $7\frac{1}{2}$ miles = 1 inch. Drawn and engraved by John Elmslie.

A further reprint of the map of 1848, as amended up to 1864 (?), but with some further additions to the railways, an amended geological colouring, and geological notes added round the outer borders of the counties. There is also inserted, on the left-hand side of the map, above the title, an "Index to sheets of Geol. Ordce. Map," and, at the foot of the map: "London. Published by J. Reynolds & Sons, 174, Strand."

From 'Reynolds's Geological Atlas of Great Britain.' "Second Edition", London, 1889, 8vo.

***1889 (c). Bacon, George Washington.** 18 × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

A further reprint of Bacon's map of the county of 1876 and 1884, apparently almost unaltered, except that the new parliamentary divisions are shown, and, at the top right-hand corner, "Hertford", in bold letters, is engraved before the number 20.

From the 'New Large-Scale Atlas of the British Isles.' London, no date, fol.

*** 1890. Hopkinson, John.** 9 × 6⅞. Scale, 5 miles = 1 inch. Lithographed by Edward Weller.

Reprint with additions of the map in the 'Flora of Herts', 1887. In the title, in the left-hand top corner, there is added, in lieu of the words "as adopted for the Botanical Districts", "and Rainfall Stations", and there is also inserted below, particulars of rainfall stations referring to signs on the map. The scale of miles is repeated lower. There are added, on the map itself, the rainfall stations in the county existing in 1889, as well as those discontinued. At the top, outside the margin on the right-hand side, is: "Trans. Herts. Nat. Hist. Soc., Vol. VI, Pl. III."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club', Vol. VI. London and Hertford, 1892, 8vo. The map illustrates 'Half-a-Century's Rainfall in Hertfordshire.' By John Hopkinson. Read 18th November, 1890, and published in December of the same year.

*** 1890. Kelly & Co., Limited.** 38 × 25. Scale, 1½ miles = 1 inch.

A further reprint of the map of 1882. At the foot, on the left-hand side: "Charles Hooper & C°., Ld., White Hart Court, and Alderman's Walk, London, E.C.", and, in the centre: "London—Kelly & C°. Ltd., Directory Offices, 182 to 184 High Holborn, W.C."

From 'Kelly's Directory of Essex, Hertfordshire and Middlesex.' London, 1890, 8vo.

1891. Foster, Albert John. 7 11/16 × 5 11/16. Scale, 8 miles = 1 inch.

A map reduced from the Ordnance Survey, in a ruled border, extending north to Biggleswade, south to London, east to Saffron Walden, and west to Aylesbury—in which the county of Herts forms the centre and is bounded by a thick broken line. The lines of the meridian of Greenwich and of 52° north latitude are ruled faintly across the map. This map contains the usual details, but without hill-shading, and the railways and stations and the principal roads are clearly marked. The title, above the map is: "Map to accompany the Guide to Hertfordshire." Below the map, on the left, a "Scale of (15) Statute Miles"; on the right: "Stanfords Geog^l. Estab^t.", and, a little lower down in the middle: "London: Edward Stanford, 26 & 27 Cockspur S^t., Charing Cross, S.W."

From the 'Tourist's Guide to Hertfordshire', by the Rev. Albert John Foster. First edition. London, 1891, 12mo.

(The map is reprinted without alteration in the second edition of the guide, published in 1896.)

1891. Ordnance Survey. About 38½ × 26½ to edge of plate. Scale, 2 miles = 1 inch. Engraved at the Ordnance Survey Office.

The index map to the Ordnance Survey of the county,

containing in the centre of the plate, which is without margin, a map of the county divided up into numbered rectangular spaces, showing the areas covered by the sheets of the 6-inch and 25-inch Survey maps.

This map gives effect to the alterations of the county boundaries made by Acts of Parliament and Local Government Board Orders up to its date. It shows boundaries and names of hundreds and parishes, the roads, railways (with stations), rivers and canals (with bridges), and the towns, villages, hamlets, houses, parks, and woods. In the right-hand top corner: "Index to the Ordnance Survey of Hertfordshire. On the scale of 6 inches to one statute mile = $\frac{1}{10\frac{1}{560}}$". Below, in columns filling the whole of the space on the right of the map itself, the parishes, with their areas, arranged in parliamentary divisions and hundreds, and a summary of the area of the county in parliamentary divisions. In the left-hand top corner is a table of references to the small parishes and detached portions of parishes, and, in the left-hand bottom corner, a table of the characters used on the 6-inch engravings of the Ordnance Survey. At the foot of the map scales of the index, etc., and: "Engraved and Published at the Ordnance Survey Office, Southampton, 1891", prices, etc., and a table of references.

(A reprint with special colouring in the same year.)

* **1891. Ordnance Survey.** About $38\frac{1}{8} \times 26\frac{1}{4}$ to edge of plate. Scale, 2 miles = 1 inch. Engraved at the Ordnance Survey Office.

A copy of the index map of the county of this date, above described, with the parliamentary divisions shown by special colouring.

* **1891. Bacon, George Washington.** 18 × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

An unaltered impression of the map of Herts issued by Bacon in his atlas of about 1889.

From the 'New Large-Scale Atlas of the British Isles.' London, 1891, fol. This map is also issued in 'Bacon's County Guide and Map of Hertford,' one of a series of county maps folded for the pocket.

1892. Evans, John. $10\frac{1}{16} \times 9\frac{3}{16}$. Scale, 4 miles = 1 inch.

A map of Herts and parts of the adjoining counties, the area of the county being uncoloured, but the surrounding districts tinted a grey-green. The map is drawn to show specially the localities of Pre-Roman, Roman, and Saxon remains. It is in a plain border, outside of which, at the top, on the left-hand side is: "Archaeologia", and on the right: "Vol. LIII, Pl. xx." At the bottom, on the right: "London. Stanford's Geog^{l}. Estab^{t}." The title, in the left-hand top corner, in a plain, rectangular space, is: "Archaeological Map of Herts", with, below it, a "Scale of (8) Eng. Miles", and, again below, an explanation of the signs used on the map.

From the '*Archaeologia*; or Miscellaneous Tracts relating to Antiquity, published by the Society of Antiquaries of London.' Vol. LIII. London, 1892, 4to. The map illustrates 'An Archaeological Survey of Hertfordshire', by John Evans, Esq., D.C.L., LL.D., Sc.D., F.R.S., P.S.A.

1892. Black, Adam and Charles. $9\frac{9}{16} \times 6\frac{3}{4}$. Scale, about 5 miles = 1 inch. Engraved by John Bartholomew & Co.

A clearly engraved map of the county, with some of the details (railways and principal towns) shown to the margin of the map itself. It contains, for the county area, the usual details, with hill-shading, and has a double-ruled border, with the latitude and longitude marked upon it in degrees and minutes. At the top, above the border, in the centre: "Herts"; on the left-hand side: "Black's Handy Atlas of England and Wales", and, on the right: "Plate 25." At the foot, in the centre: "Published by A. & C. Black, London"; on the left: "The Edinburgh Geographical Institute", and, on the right: "John Bartholomew & C°." Within the border of the map, in the right-hand bottom corner, is a list of the "Parliamentary Divisions 1885," and, below it, a scale of 7 miles.

From 'Black's Handy Atlas of England and Wales'. London, 1892, 8vo. This work contains 10 general maps, 40 county maps, and 14 town plans, etc.

*** 1892 (c). Walker, John and Charles.** $15\frac{1}{4} \times 12\frac{1}{2}$. Scale, 1 mile = $\frac{3}{4}$ inch.

Also a reprint of Walker's folding pocket map of the county by Stanford. It is unaltered from the map of 1885 (c), except that the population of 1891 is inserted in manuscript. London, no date, 12mo.

*** 1893. Hopkinson, John.** $5\frac{1}{4} \times 4\frac{3}{4}$. Scale, 8 miles = 1 inch. Lithographed by Edward Weller.

A reprint of Hopkinson's map of 1889, from which it differs in the county area being tinted pale salmon colour, the imprint at foot wanting the date, and the legend at the top reading: "Trans. Herts. Nat. Hist. Soc., Vol. VII, Pl. III."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club,' Vol. VII, London and Hertford, 1894, 8vo, illustrating 'Climatological Observations taken in Hertfordshire in the Year 1891.' By John Hopkinson. Read 21st March, and published July, 1893.

1894. Brabner, J. H. F. $11 \times 8\frac{1}{4}$. Scale, 4 miles = 1 inch. Engraved by F. S. Weller.

Map of Herts showing parliamentary divisions, and rivers, canals, roads, railways (with stations), with the towns, principal villages, parks, woods, and hills. The details extend beyond the county boundary to the border of the map. Lines of latitude and longitude are drawn across the map, which has a plain line border, and, in the left-hand top corner: "Hertfordshire", and,

below, a scale of (5) miles, and indications of the railways, roads, and canals. Below the map, on the right: "F. S. Weller, F.R.G.S.," and in the centre: "William Mackenzie, London, Edinburgh, and Glasgow."

From 'The Comprehensive Gazetteer of England and Wales', edited by J. H. F. Brabner, F.R.G.S. London, 6 vols., no date, large 8vo. The map of Herts is in volume iii. In the British Museum Library the date-stamp in vols. i, ii, and iii is 1894, and that in vols. iv, v, and vi, 1895.

1894. Hertfordshire County Council. 28 × 20¼. Scale, 2 inches = 1 mile. Lithographed by Robert J. Cook & Hammond.

Sketch-map having the same details as the map on a smaller scale of the same date, but with the addition of the areas within adjacent counties which are included in those poor law unions which are partly in Hertfordshire. In the left-hand top corner: "Hertfordshire", and a "Scale of (10) Miles." In the left-hand bottom corner: "April, 1894." In the right-hand top corner a small star-indicator of the cardinal points, and, in the right-hand bottom corner, a reference to character of lines indicating county and other boundaries and railways, and below: "Rob^{t}. J. Cook & Hammond, lith. Broadway, Westminster."

Prepared for the use of the Herts County Council.

*** 1894. Hertfordshire County Council.** 14⅛ × 11⅝. Scale, 3 miles = 1 inch. Lithographed by Robert J. Cook & Hammond.

Another reprint of the sketch-map of 1887, but a less clear impression, and altered by the omission of the text under the title, by the colouring of areas proposed to be transferred to or from other counties, and by the addition, in the right-hand bottom corner, above the scale of miles, of: "Reference. Portions proposed to be added to Herts colored Red. Portions proposed to be taken from Herts colored Blue", and of: "S.W." after the word "Westminster", below the scale of miles.

Prepared for the use of the County Council upon the consideration of the proposals for the alteration of the county boundary made in consequence of the coming into operation of the Local Government Act, 1894.

*** 1894. Kelly & Co., Limited.** 38 × 25. Scale, 1½ miles = 1 inch.

Another impression of the map of 1882, with the imprints of 1890, and variations in the figures of population, etc.

From 'Kelly's Directory of Essex, Hertfordshire and Middlesex.' London, 1894, 8vo.

1895. Murray, John. 10¾ × 13. Scale, 4 miles = 1 inch. Engraved by J. Bartholomew, Edinburgh.

A map of Herts and Beds and parts of the adjoining counties. It is a good, clear impression, giving the usual details, and has

a double-lined, plain border, the inner line broken in several places on the left, and in the centre at the bottom of the map. At the top, outside the margin: "Counties of Hertford and Bedford"; at the bottom, on the left-hand side: "Copyright"; and, in the centre, a scale of (8) "English Miles." Below the map: "London, John Murray, Albemarle Street", and (on the right): "J. Bartholomew, Edin^{r}".

Issued with Murray's 'Handbook for Hertfordshire, Bedfordshire, and Huntingdonshire.' London, 1895, 8vo. There are three sectional maps of Herts in the work itself, on the scale of 2 miles to an inch, viz.: "S.E. portion of Herts", "Hertford, Ware, Hatfield, and neighbourhood", and: "W. portion of Herts."

* **1895. Bacon, George Washington.** $18\frac{3}{16} \times 12$. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

Another copy of Bacon's map of the county of 1889, etc., very slightly wider than that of 1891, but otherwise unaltered, except as follows:—the explanation of terms is re-written and amplified, and below it is inserted a reference to the colours used to distinguish the parliamentary divisions on the map, and a statement of the populations of these divisions and the county in 1881 and 1891; the "note", already referred to as transferred from the right-hand bottom corner (impression of 1884), is re-written in that corner; the indicator of the points of the compass is erased; outside the border of the map, at the right-hand top corner, is added a list of "Adjoining Counties", with the pages at which these maps are found in the atlas, and at the foot, on the left-hand side, the imprint: "Bacon's Geographical Establishment."

From the 'Commercial and Library Atlas of the British Isles.' London, 1895, fol.

* **1895. Philip, George, & Son.** 8×6. Scale, 6 miles = 1 inch.

A Hertfordshire county map reprinted after that of 1885, with further slight additions to the railways, and, below the title, the following added: "Note Railway Stations marked 'Sta.' bear the same name as their nearest town or village."

From 'Philips' Handy Atlas of the Counties of England.' London, 1895, sm. 8vo.

* **1896. Foster, Albert John.** $7\frac{1}{16} \times 5\frac{7}{16}$. Scale, 8 miles = 1 inch.

An unaltered reprint of the map of Herts of 1891.

From the 'Tourist's Guide to Hertfordshire.' Second edition. London, 1896, 12mo.

* **1896. Hopkinson, John.** $5\frac{1}{8} \times 4\frac{1}{8}$. Scale, 8 miles = 1 inch. Lithographed by Edward Weller.

A reprint of Hopkinson's maps of 1889 and 1893, tinted, with the words: "showing Rainfall Stations" inserted in the

title, in lieu of "showing its Climatological Stations", and corresponding alterations on the map itself. Outside the top right-hand corner of the map: "Trans. Herts. Nat. Hist. Soc., Vol. IX, Pl. I."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club', Vol. IX. London and Hertford, 1898, 8vo. This map illustrates a paper on 'Hertfordshire Rainfall, Percolation, and Evaporation.' By John Hopkinson. Read 17th March, 1896, and published in July of that year.

*** 1896. Hopkinson, John.** 5⅞ × 4⅝. Scale, 8 miles = 1 inch. Lithographed by Edward Weller.

Another reprint of Hopkinson's map of 1889 and 1893 which differs only from the last noted in having a darker tint, and in the number in the legend above the map being Pl. II in lieu of Pl. I.

From the 'Transactions of the Hertfordshire Natural History Society and Field Club', Vol. IX. London and Hertford, 1898, 8vo, illustrating 'Climatological Observations taken in Hertfordshire in the year 1895.' By John Hopkinson. Read 21st April, and published in September, 1896.

*** 1896 (c). Bacon, G. W., & Co., Limited.** 25⅛ × 17⅛. Scale, 2 inches = 1 mile.

A map of the county re-engraved after that of B. R. Davies, described under date 1878 (?), and slightly larger. It contains the same details, except that those outside the boundaries of the county are much more complete. The border is partially broken just north of Ashwell, and also very slightly at North Marston, in Buckinghamshire. The Great Northern Railway is carried into the border at Wood Green. Corrections are made in the positions of railway stations, and in the names of railways. The map is ruled-up into squares numbered along the top and bottom, 1 to 9, and lettered at sides, A to G. The title, in the left-hand top corner, now reads: "Bacon's Map of Hertfordshire revised throughout by the New Ordnance Survey, Divided into 5 mile squares", with, below, a scale of "English miles, 69·1=1 Degree", and, again below: "References", extending to a considerable number of details. Against the border on the right-hand side of the map is a slightly-drawn indicator of the points of the compass, and, in the right-hand bottom corner: "Note—The official names of Railway Stations are all engraved in a special character, thus, **Ludgate,** except where indicated by the name of the town being in bold letters, and identical with the name of the Station." Below the map, outside the left-hand bottom corner: "G. W. Bacon & C°., Ltd., 127 Strand, London."

This appears to be from another issue of Bacon's pocket county maps for cyclists and tourists, which have been published annually for the last ten or twelve years, corrected and amended from time to time.

*** 1897. Bettesworth, W. A.** 16¼ × 13¾. Scale, 2½ miles = 1 inch. Engraved by George Philip & Son.

A further impression from Philip's plate of 1875, 1885, etc., with the indication: "Railways constructing" omitted, as well as the number and imprint, the latter being replaced by "Iliffe & Son, Map Printers, Coventry and London."

From 'The Way About Hertfordshire', No. 7 of 'The Way About Series of Gazetteer Guides.' London, no date, 8vo.

*** 1897. Austin, Stephen & Sons.** 16¼ × 13¾. Scale, 2½ miles = 1 inch. Engraved by George Philip & Son.

A map of the county from Philip's plate of 1875, 1885, etc., as amended up to this date. At the foot, in the centre, below the border: "Hertfordshire Almanac." On the right: "George Philip & Son, London and Liverpool."

From 'The Hertfordshire Almanac and County Handbook',* for the year 1898. Hertford, no date, 8vo. It is described on the cover of the almanack as a new map of the county.

*** 1897. Fordham, Herbert George.** 5¼ × 4¼. Scale, 8 miles = 1 inch. Lithographed by Edward Weller.

An uncoloured and altered reprint of Hopkinson's map of 1889, 1893, and 1896, with the title: "Map of Hertfordshire Showing localities in which the Earthquake of 17th Decr., 1896, was felt." These localities are shown by dots on the map, and a number of names are inserted. Outside the margin, at the left-hand bottom corner: "J. H. & H. G. F. del." and, at the top of the map above the border on the right-hand side: "Trans. Herts. Nat. Hist. Soc., Vol. IX, Pl. V."

From the 'Transactions of the Hertfordshire Natural History Society and Field Club,' Vol. IX. London and Hertford, 1898, 8vo. It illustrates a paper on 'The Earthquake of the 17th of December, 1896, as it affected the County of Hertford', read 6th April, 1897, and published in the October following.

*** 1897. Bacon, George Washington.** 18⅛ × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

Another edition of the map of 1889, as altered in 1895.

From the 'Commercial and Library Atlas of the British Isles.' London, 1897, fol.

*** 1898. Kelly's Directories Limited.** 38 × 25. Scale, 1½ miles = 1 inch.

A reprint of the map of Herts of 1894 and previous dates, but with the parliamentary divisions shown by different colours, and the parks coloured bright green. It differs from the last impression by having the letters A to D on the map to indicate the parliamentary divisions, and the insertion of the names of

* This almanack first appeared in 1848 (for the year 1849) under the title: 'The Hertfordshire Almanac, and General County Miscellany, for the year of our Lord, 1849 (to be continued annually).' The Preface is dated Dec. 19, 1848, and it is "Printed and Published (for the Proprietors) by Stephen Austin." Hertford, no date, 12mo.

these divisions to the left of the list of hundreds in the right-hand bottom corner. The only imprint runs: "London—Kelly's Directories Limited, 182 to 184 High Holborn, W.C."

From 'Kelly's Directory of Essex, Hertfordshire and Middlesex' (sub-title: 'Kelly's Hertfordshire Directory'). London, 1898, 8vo.

*** 1898. Austin, Stephen, & Sons.** 16⅛ × 13⅜. Scale, 2½ miles = 1 inch. Engraved by George Philip & Son.

An unaltered reprint of the map of 1897, but with advertisements printed on the back.

From the 'Hertfordshire Almanac and County Handbook' for 1899. Hertford, no date, 8vo.

1899. Ordnance Survey. On sheet about 17½ × 21. Scale, 4 miles = 1 inch. Heliozincographed and published at the Ordnance Survey Office.

A sketch-map, without border, showing the boundaries of parishes and the sites of towns and villages, with the county boundary, the railways, and the outlines, with their numbers, of the sheets of the various ordnance maps which are within, or contain part of, the county area. In the left-hand top corner: "Ordnance Survey of England and Wales. Combined Index shewing Civil Parishes of the Ordnance Survey Maps of Hertfordshire on the 1-inch, 6-inch, and 25-inch Scales. Surveyed in 1863–86. Revised in 1896–97." At foot are various particulars, and a scale of (12) miles, and, on the right-side of the sheet, are enlarged sketch-plans showing the boundaries of the parishes in and around Hertford and St. Albans. Dated, below the scale, 1899.

*** 1899. Austin, Stephen, & Sons.** 16⅛ × 13⅜. Scale, 2½ miles = 1 inch. Engraved by George Philip & Son.

Another unaltered reprint of the map of Herts of 1897 and 1898, with advertisements on the back.

From the 'Hertfordshire Almanac and County Handbook' for 1900. Hertford, no date, 8vo.

*** 1899. Bacon, George Washington.** 18$\frac{3}{16}$ × 12. Scale, about 3 miles = 1 inch. Engraved by B. R. Davies.

The map of Herts reprinted unaltered as in the impressions of 1895 and 1897.

From the 'Atlas and Gazetteer of the British Isles.' London, 1899, fol. It contains 70 maps in all.

1900. Ordnance Survey. About 29 × 25. Scale, 2 miles = 1 inch. Engraved at the Ordnance Survey Office.

A reprint, with amendments, of the index map of 1891. It gives effect to the alteration of county, district and parish boundaries up to its date. The tables of areas of parishes and of characteristics are omitted, as well as that of references to small parishes and detached parts, this latter being replaced by a smaller table in one column, instead of two, in the left-hand

bottom corner. In the left-hand top corner the title (in substitution for that of the map of 1891) runs: "England and Wales. Diagram of Hertfordshire, Shewing Unions, Sanitary Districts, Boroughs, and Civil Parishes; and the sheet lines of the ordnance survey maps on the scale of 25·344 inches to 1 mile ($\frac{1}{1000}$). Surveyed in 1865–79. Revised in 1896–97." Below is a reference to the colours on the map, and: "N.B. The Boundaries on this Diagram are revised up to date (6.12.99)." In the right-hand bottom corner is an "Enlarged Sketch of the Town of Hertford" coloured blue, and, below, a table of references to ordnance sheets, etc., and, at bottom of the map, scales, date (1900), and other particulars. The urban districts are coloured brown, the borough areas blue, the boundaries of poor law unions red, and the rural districts blue.

*** 1900. Austin, Stephen, & Sons.** 16⅛ × 13⅜. Scale, 2½ miles = 1 inch. Engraved by George Philip & Son.

A further reprint of the map of Herts, but with the railways shown by thick black lines, and so differing from the previous issues.

From the 'Hertfordshire Almanac and County Handbook' for 1901. Hertford, no date, 8vo.

[1833.]

[1648.]

DDITIONS AND CORRECTIONS.

[Transactions, Vol. XI, pp. 1–32 and 173–212.]

PART I.

Page 13, line 19, etc. For "*Britanniæ*" read "*Britaniæ.*"

Page 14. Philemon Holland was born at Chelmsford, and settled in Coventry, where he died in 1636, in the 85th year of his age, and where a monument was erected to his memory in Trinity Church.*

Page 15, line 1. Insert an asterisk (*) before "1611."

John Speed was born at Farndon, in Cheshire, in 1555, and began life as a tailor. He died in 1629, at the age of 74, a few weeks after his wife.†

Page 18, line 12. Insert an asterisk (*) before "1620 (?)."

Page 25, line 11 from the bottom. For "third" read "fourth."

Page 26, line 11 from the bottom. Insert an asterisk (*) before "1657 (?)."

Page 28, line 2. For "*Descriptionibus Illustrator*" read "*descriptionibus illustratur.*"

Page 30. "Le 22 de février 1672 la librairie de Blaeu périt par les flammes, avec les planches de son grand Atlas et les exemplaires qu'il avoit encore chez lui." ('*Bibliothèque curieuse,*' David Clément, Göttingen, etc., 1750–60, 4to, tome iv, note at p. 277.)

1670 (c). Morden, Robert.‡ 2¼ × 2¼. Scale, 20 miles = 1 inch.

An outline map of Hertfordshire with a panel above with the name "Hartford Sh:" in the centre, a small numeral 8 on

* See Cooke's 'Topographical and Statistical Account of the County of Warwick,' London, no date, 12mo.

† See Dugdale's 'New British Traveller,' vol. i, p. 329 and note. London, 1819, 4to.

‡ In the account of Robert Morden in the 'Dictionary of National Biography' (Vol. 38, at p. 410), it is stated that he commenced business about 1668, and in 1688 was in partnership with Thomas Cockerill at the Atlas, Cornhill. He died in 1703. Amongst his publications are mentioned:—'Geography Rectified,' with 76 maps, London, 1680, 4to, of which a second edition appeared in 1688, a third in 1693, and the fourth in 1700; an 'Atlas of Modern Geography,' without title or date, issued about 1690, and the 'Pocket-Book.'

the left and a large one in roman characters on the right. In a panel below:

"Length. _____ 30.
"Bredth. _____ 28.
"Circumference. _____ 130.
"Hartford { D. from Lon: ____ 20° 22. / Lattitude _____ 51 50'."

The map, including the panels, measures 3⅛ inches in height. It shows the boundary of the county and the boundaries of adjoining counties as far as the margin of the map, by dotted lines, with the principal and some less important roads (distinguished by double and single lines respectively), the rivers, and a few towns. Towards the left-hand top corner, within the county of Bedford, is a small circular indicator of the points of the compass, the north indicated by an arrow-head and the east by a cross. In the right-hand bottom corner a scale of ten miles.

From 'A Pocket Book of all the Counties of England and Wales: Wherein are describ'd, the Cheif Cities, Market-Towns and others; With the Rivers and Roads from London. To which is added, a Compass, shewing the Bearing, and a Scale for the Distance of Places. There is also given the Length, Breadth, and Circumference of each County: The Latitude of each City or Town, and its Distance from London. Being a necessary and plain Direction for Travelling to any Place or Town in all England or Wales. Sold by Robert Morden at the Atlas in Cornhil, and Joseph Pask Stationer, at the three Ink-bottles in Castle-ally, under the west-end of the Royal Exchange.' London, no date, 12mo. This is a little, tall, narrow book in the Library of the British Museum, dated in the Catalogue 1670 (?). It contains a series of small county maps mounted two on a page, the title-page and a blank flyleaf being similarly mounted. On the back of the binding is: "Pocket Book of Counties of England and Wales. R. Morden."

(Reprinted by H. Turpin in a little book dated doubtfully 1780 in the British Museum Catalogue.)

Page 31, line 3. Insert an asterisk (*) before "1671 (?)."

PART II.

Page 181, line 12. For "1700 (c)" read "1701;" this date being given in Nichols' 'Catalogue of the Hoare Library' (1840), under the head of General Topography, at p. 98.

Page 183, line 11. Insert an asterisk (*) before "1713 (c)."

Page 187.

1726. Overton, Philip, and Thomas Bowles. 37 × 23½. Scale, about 2¼ miles = 1 inch.

A map of Essex, Middlesex, and Herts, of which the county of Hertford occupies a space measuring about 17 × 15¼. It

shows the roads, rivers, towns, villages, and the principal houses and parks, and is ruled up into squares. The title, in the right-hand bottom corner, runs: "The Counties of Essex, Middlesex and Hertfordshire Actualy Survey'd by Several Hands Corrected and Amended and Humbly Dedicated to the Nobility and Gentry of the Said Counties By Phil: Overton Mapseller in Fleet Street and Tho: Bowles Mapseller in S. Pauls Churchyard 1726." In the left-hand top corner is a plan of St. Albans in a panel. This plan has to the left-hand side a "Scale of Perches," and at the top, near the right-hand side, a circular indicator of the points of the compass, with the north turned to the corner of the plan. Below this plan is a nearly circular panel, ornamented with scrolls containing the title: "St. Albans Humbly Inscrib'd to Tho: Gape Esq^{r}."

A copy of this map—the only one I have seen—is in the Library of the British Museum.

Page 188, line 20. There is also a map of "Cambridgeshire and The Great Levell of y^{e} Fenns" with Lea's and the Bowles' imprints, and the date 1733, which is reprinted from the plate of a map found in Lea's Atlas in the Pepysian Library. See under date 1689.

***1738. Cox, Thomas.** $8\frac{1}{4} \times 6\frac{5}{8}$. Scale, about 5 miles = 1 inch. Drawn by Robert Morden.

Another impression of the map of Herts in Morden's small atlas of 1701 and 1704, as amended and reprinted in the '*Magna Britannia*' of 1720–31.

From a second edition of the '*Magna Britannia*,' with the title slightly altered to: '*Magna Britannia Antiqua et Nova*: or, a Survey of the Ancient and Present State of Great Britain . . . ' London, 6 vols., 1738, 4to.

Page 189, line 1. I have now obtained a copy of this atlas. London, 1739, obl. fol. It is bound up with a copy of Moll's 'Atlas Minor.'

Line 5, after "Maps of" insert "the Counties of."

Page 193, line 18. For "right" read "left."

Line 16 from the bottom. The measurements and scale of the map described under "1748. Wale, S.," are, accurately, $6\frac{9}{16} \times 5\frac{9}{16}$ and $4\frac{3}{4}$ miles = 1 inch respectively. Add to the description:—In the right-hand bottom corner is a star-shaped indicator of the points of the compass, with an ornamental arrow-head at the top, and the other cardinal points indicated by letters, W., S., and E. Below it is a scale of miles. The full title of the collection of maps, in a copy bound in 1 vol., 8vo, in my library, is:—'*Geographia Magnae Britanniae*, Or, Correct Maps of all the Counties in England, Scotland, and Wales; with General ones of both Kingdoms, and of the several Adjacent Islands: Each Map expressing the Cities, Boroughs, Market and Presbytery Towns, Villages, Roads and Rivers; with the

No. of Members sent to Parliament; together with Tables of the high and cross Roads, Market Days, etc.,' with, at foot:—"Published according to Act of Parliament October 12th, 1748." The list of (60) maps in this copy does not include any general ones or any of the counties of Scotland.

Page 194.

1749. Kitchin, Thomas. 25¾ × 20¾. Scale, about 1¼ miles = 1 inch.

This appears to be the original issue of the map of Hertfordshire afterwards published by Bowen & Kitchin in 'The Large English Atlas', of which various undated editions are catalogued as of 1760 (c), 1763 (c), 1777 (c), and 1785 (c). The impression of this early copy is very clear. It has the imprint at foot: "Sold by I. Hinton at the King's Arms in St. Pauls Church yard London 1749," by which it is distinguishable from later issues. There is a copy in the British Museum Library, with one of the map of Cambridgeshire from the same series, also bearing Hinton's name, with the date 1751.

Page 198, line 18 from the bottom. Insert an asterisk (*) before "1760 (c)."

Page 199, line 9 from the bottom. For "Searle" read "Seale."

Line 2 from the bottom. An impression of the map of Herts, in a fine state, bearing the imprint of John Hinton and the date 1749, as well as a similar map of Cambridgeshire dated 1751, are in the British Museum, and these are the dates, no doubt, of the first issues of these individual maps.

Page 200, line 2. I have also an atlas of these maps, with the same title, which appears to have been issued about 1777 (see *post*, p. 138).

Line 27. This little atlas was re-issued, it seems, in 1779.

Page 201, line 23. For "Hertfordshire" read "Hartfordshire."

Line 6 from the bottom. For "7⅛ × 6," read "7⅛ × 6 1/16."

Page 206.

1767 (c). Bowen, Emanuel. 19⅞ × 16¼. Scale, about 2¼ miles = 1 inch.

A map in the style of and containing the same particulars as Kitchin's map of Herts in the 'English Atlas,' described under the date 1778 (c) at pp. 207 and 208. The imprint differs from the map so described, and is as follows:—"Printed for R. Sayer and J. Ryall in Fleetstreet, T. Bowles in St. Pauls Church Yard, J. Bowles & Son and Mess. Bakewell & Parker in Cornhill, H. Overton without Newgate and T. Kitchin on Holborn Hill."

This map seems otherwise identical with that cited above, even to the "No. 16" in the left-hand bottom corner of the plate,

below the margin of the map, and to be a copy of the map now in the Herts County Museum (Lewis Evans Collection).

From 'The Royal English Atlas: being a New and Accurate Set of Maps of all The Counties of South Britain, Drawn from Surveys, and the best Authorities; . . . ', described on the title-page as "By Emanuel Bowen, Geographer to His late Majesty, Thomas Kitchin, Geographer, and Others." London, no date, fol.

This is the atlas referred to by Gough, as noted at p. 206. It contains 44 maps. The only copy I have seen was one in the possession of a bookseller.

Page 207.

***1777 (c). Kitchin, Thomas** 25¾ × 20¾. Scale, about 1½ miles = 1 inch.

An unaltered impression of Kitchin's large map of the county of 1749, as re-issued in 'The Large English Atlas' of 1760 (c) and 1763 (c). This map is from a copy of the atlas in my collection. London, no date, imp. folio. It contains 47 maps only, and is "Printed and Sold by Robert Sayer, Map and Print-seller, at No. 53, in Fleet Street." Two maps in this atlas are dated in 1777:—England and Wales, June 12th, and Ireland, April 1st, and, as no later date appears in any part of the work, this issue may be ascribed pretty safely to about this year. The map of Herts has the following imprint at the foot: "Printed for Robt. Sayer in Fleet Street, John Bowles in Cornhil, and Carington Bowles in St. Pauls Church Yard."

Line 29. See 'The Royal English Atlas,' by Bowen & Kitchin and others. London [1767 (c)], fol.

Page 208, line 7. For "Counties of" read "Counties in."

***1779. Gibson, John.** 4 1/16 × 2½. Scale, 16 miles = 1 inch.

An edition of the 'New and Accurate Maps of the Counties of England and Wales (1760 c)' was "Printed for T. Carnan and F. Newbery, jr., 1779," * and this edition contained, no doubt, the map of Herts noted under date 1760 (c).

From the same press was also issued in 1777 (?) 'A Geographical Description of the Counties of England and Wales, on Cards, with Direction for Playing.' "Price 2s. the Pack," * but it is not clear whether these cards had on them maps of the several counties or only letterpress descriptions.

***1780 (?). Morden, Robert.** 2½ × 2½. Scale, 20 miles = 1 inch.

A re-issue, unaltered, of the map of Herts in Morden's 'Pocket Book' of about 1670, in a set of Morden's thumb-nail

* See 'A Bookseller of the Last Century,' by Charles Welsh, London, 1885, 8vo, containing a list of books published by John Newbery, and his successors, Francis Newbery, E. Newbery, and others, between 1740 and 1802.

county maps with a new title, and with an introduction running to p. viii. These maps are not paged, and are mounted as if cut out of an older volume. The title runs: 'A brief Description of England and Wales Containing A particular Account of each County; . . . Embellished with maps of each County. Very useful for Travellers and others, and very proper for Schools, to give Youth an Idea of Geography, and the Nature of his own Country, and each County.' It is: "London: Printed for H. Turpin, No. 104, St. John's Street, West Smithfield," no date, 24mo.

I do not know upon what authority the above date is fixed. It is that given in the Catalogue of the Library of the British Museum.

Page 210, line 23. For "$10\frac{1}{8} \times 8\frac{3}{16}$" read "$10\frac{7}{16} \times 8\frac{5}{16}$," and for "$4\frac{1}{2}$" read "$4\frac{1}{4}$."

Page 211, line 7. Note to the date "1793." This plate was re-engraved very closely after the original. It was used by G. F. Cruchley in 1863, 1868, 1872, and 1875, and probably at other dates. The plate and stock of maps were purchased by Gall & Inglis, of Edinburgh, in whose possession they now (1907) are. The stock of maps has not been exhausted, and I am informed that there has been no reprint since 1876–7, the date of purchase.

[Transactions, Vol. XII, pp. 169–208.]

Page 171, line 22. For "J. & G. Cary" read "G. & J. Cary."

PART III.

Page 190.

***1824. Gray, George Carrington.** $4\frac{3}{4} \times 4\frac{1}{4}$. Scale, 10 miles = 1 inch.

An unaltered reprint of Cooke's map of Herts of 1806 (c) and subsequent dates, with the number 19 added above the right-hand top corner.

From 'Gray's New Book of Roads. The Tourist and Traveller's Guide to the Roads of England and Wales, and Part of Scotland, on an entirely new Plan, ...' By George Carrington Gray. London, 1824, 12mo. This little work consists of an itinerary, with frontispiece map of England, preface, table of distances, etc., followed by a set of county maps reprinted from Cooke's plates with some additions, and by an index. The maps number 49, and include an index-map of England and Wales, one of the South of Scotland, one of "The Lakes," a folding map of "Derbyshire and parts of the Seven adjacent Counties, Comprehending the Country round Derby Matlock and Buxton," "The Isle of Thanet," maps of North Wales and South Wales, and of the three ridings of

Yorkshire, with 39 of the English counties, and a reference table of the maps. The only copy known to me is one in my collection.

Page 192.

***1825. Capper, Benjamin Pitts.** 7 × 4 1/16. Scale, 8 miles = 1 inch. Drawn and engraved by Cooper.

Another reprint of the map of Herts of 1808 and 1813, with the alterations noted on the impression of 1826.

From 'A Topographical Dictionary of the United Kingdom.' London, 1825, 8vo.

Page 194, line 17 fro
Rickmansworth to
1795, and was recit
1812, but no work s

Page 198, line 9. Insert

Page 206, line 15. For '

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AND

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EDITED BY JOHN HOPKINSON, F.L.S., F.G.S., F.Z.S., F.R. Met. Soc., Assoc. Inst. C. E., Sec. Ray Soc.

VOL. XIII. PART 3.

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HERTFORD:
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Evening meetings of the Society are held in the rooms of the Watford Urban District Council (Upton House) once a month during the Winter and Spring, and also occasionally at St. Albans and other places. Field meetings are held during the Spring and Summer in various parts of the County.

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XIV.

HERTFORDSHIRE EARTHQUAKES.

By John Hopkinson, F.L.S., F.G.S., F.Z.S., F. R. Met. Soc., Assoc. Inst. C. E.

Read at Watford, 29th January, 1907.

I. Introduction.

Owing to the disastrous earthquakes which have recently taken place in Columbia, California, and Chili, all within the first eight months of last year, and all on the west coast of America, such catastrophes, and the phenomena attendant upon them, have lately excited so much interest that I thought this might be an appropriate time to bring before our Society the records which I have been able to find of earthquakes which have occurred in Hertfordshire. Moreover, during the present month not only have two other great earthquakes occurred—one in Jamaica reducing to ruins its capital, Kingston, and the other in Sumatra nearly annihilating the island of Simalu, both being attended by great loss of life—but seismic disturbances are taking place in all parts of the world, including our own country, for earthquakes have occurred within the month at Newport in Monmouthshire and at Oban in Argyllshire.

"Earthquakes have been properly distinguished into natural and supernatural," said an early writer.* This classification would not be accepted in the present day, for we now endeavour to find a physical cause for all phenomena which occur in the universe. The origin of earthquakes has for long engaged the attention of scientific men, and those who have lately given the subject the most careful attention are in fair agreement as to the origin of nearly all being from one of three causes—(1) the faulting of strata or slipping of rock-masses one over the other from the contraction of the earth owing to the loss of its internal heat; (2) the formation of hollow spaces either from chemical disintegration of rock as by the solvent action of water in limestone districts or from the ejection of ashes and lava by volcanic eruptions, and the subsequent falling-in of the superincumbent strata; and (3) explosion of steam from the admission of water into highly-heated portions of the earth's interior by gradual percolation, or through fissures in the bed of the ocean. All possible causes are not exhausted by these three, for there is one other at least, which, although at one period frequently advanced, appears lately to have been ignored, and that is a discharge of electricity, as in the "return-shock" from the earth to the atmosphere. The question as to whether

* Rev. A. Bruce: 'An Historical Account of the most remarkable Earthquakes and Volcanic Eruptions,' p. 4 (1797).

there is sufficient evidence to justify this being brought into consideration as at least a probable hypothesis is of interest in connection with the latest earthquake recorded in our county, and the hurricane and thunderstorm which preceded it.

The vast majority of earthquakes are doubtless caused by such disturbances of the strata as we find recorded by faults in almost all geological formations. These are termed tectonic.*

It was the opinion of Prof. John Phillips† that an earthquake happened in Hertfordshire and the valley of the Thames after the Chalk period, but the effect noted, which he tersely states as "pebble beds, wasted surface of chalk," is not decisive evidence.

We have perhaps better evidence of slight earthquakes in our county in post-Cretaceous times in the more or less vertical slickensided surfaces of chalk occasionally seen in our chalk-pits; and in post-Tertiary times in faults in the London Clay and the Reading Beds, as at Bennett's End near Hemel Hempstead. It is probable that the anticline in the Chalk passing through Hertfordshire from Reed Hill south of Royston in a south-westerly direction to Pinner in Middlesex and onwards to Windsor was the result of an earthquake. The movement which gave to the Chalk and overlying Eocene beds the shallow basin-shaped form from which the district on the north-western margin of which Hertfordshire is situated has been named the London Tertiary basin, must have been too gradual to be perceptible as a shock or series of shocks, although it is believed to have taken place in Miocene times during a period of great seismic activity in the north of Britain, where volcanoes were then in active eruption.

II. Recorded Hertfordshire Earthquakes.

Coming to historic times there is good reason to believe that many earthquakes which are recorded to have happened in England must have affected Hertfordshire, although we are without local records. These are chiefly such as have been described as of general occurrence all over England, or as affecting localities on two or more sides of the county. In the following enumeration only those are included which have been reported as having been felt, or as having produced visible effects, in Hertfordshire, and the number which I have found recorded, omitting a few evidently erroneous records, is twelve.

* The theory has, however, recently been advanced by Professor See that all great earthquakes are caused by the percolation of oceanic or surface waters to the molten matter beneath the more solid crust of the earth, and he ascribes the greater frequency of earthquakes in the vicinity of deep coastal waters to the greater depth and therefore weight of the superincumbent water rather than to the increased weight of the terrestrial strata. Prof. See has charge of the U.S. Naval Observatory at Mare Island, California, and studied the San Francisco earthquake.

† 'Manual of Geology,' p. 573 (1855).

13*th December*, 1250.

The first Hertfordshire earthquake of which we have any record has been mentioned by at least fourteen authors, but all seem to have derived their information from Matthew Paris, the first edition of whose justly-esteemed 'Historia Major' was printed in 1571. This earthquake is of special interest to us as it was felt at St. Albans and in its neighbourhood, extending so far as the Chiltern Hills, and it appears to have been a purely local one. There is no record of an earthquake on the same day nor even in the same year anywhere else in England, or in any other country. The account of the Latin chronicler, who was a Benedictine Monk of St. Albans, is thus translated by the Rev. Dr. Giles:—

"Of an Earthquake in Chiltern, in England.

"In the same year [1250], on the day of St. Lucia [Dec. 13], about the third hour of the day, an earthquake occurred at St. Alban's and the adjacent districts, which are called Chiltern, where from time immemorial no such an event had been seen or heard of; for the land there is solid and chalky, not hollow or watery, nor near the sea; wherefore such an occurrence was unusual and unnatural, and more to be wondered at. This earthquake, if it had been as destructive in its effects as it was unusual and wonderful, would have shaken all buildings to pieces: it came on with a trembling motion, and attended by a sound as if it were dreadful subterranean thunder. A remarkable circumstance took place during the earthquake, which was this: the pigeons, jackdaws, sparrows, and other birds which were perched on the houses and on the branches of the trees, were seized with fright, as though a hawk were hovering over them, and suddenly expanding their wings, took to flight, as if they were mad, and flew backwards and forwards in confusion, exciting fear and dread in those who saw the occurrence; but, after the trembling motion of the earth and the rumbling noise had ceased, they returned to their usual nests, which had been disturbed by the earthquake. This earthquake, indeed, struck terror into the hearts of all, which I think to be more than amazement or fear, and it was believed to be indication of future events. In this year, the land as well as the sea was affected by unusual and dreadful commotions, which, according to the threatening words of the Gospel,—'there shall be earthquakes in divers places,' threateningly foretold that the end of the world was at hand."

Matthew Paris died at St. Albans in the year 1259, and doubtless was an eye-witness of this occurrence. Some years before his work was printed, a condensed account of this earthquake appeared in the 'Flores Historiarum,' usually attributed to Matthew of Westminster, but considered by Sir Frederick Madden to have been in great part written by Paris as an abridgment of his 'Historia Major,' the earlier portion of which,

to the year 1237, was but little more than a transcript of the 'Flores Historiarum' of Roger of Wendover, also a St. Albans Monk, who died in that year. This condensed account, which proves that Matthew Paris was *not* its author, is thus translated by C. D. Younge:—

"The same year too [1250], on the day of Saint Lucia, about three o'clock, an earthquake took place in England, and it is a very marvellous thing that such an event should take place in that country, nor has such a thing ever taken place within any one's recollection, except in this instance. For the island is solid, and rocky, and very destitute of caverns. Moreover, with the earthquake, there was also a terrible noise as of thunder, and a subterranean roaring, events which were said to presage some impending pestilence of no small importance, or some revolution in the kingdom, or the death of some famous prince."

That this was not written by Matthew Paris is shown first by his statement that an earthquake was an unusual occurrence for the chalk area of the vicinity of St. Albans and the Chilterns, away from the sea, being misconstrued into the statement that it was a marvellous thing for one to take place in England, and next by the fact that, of the twenty-five or thirty English earthquakes previously recorded, Paris described, in his 'Historia Major,' one in London in 1247 and another at Wells, etc., in 1248, and also stated that there were frequent earthquakes in England in the half-century ending 1250.

25*th May*, 1551.

Three centuries elapse before we have another record, and for that we are indebted to John Stow, who in the first edition of his 'English Chronicles' (1565) mentions one on the 25th of May, 1551, as having been felt at Albury, and in the second edition (1580) adds Bennington. This addition is important, for it was most widely felt in Surrey and there is an Albury in that county. There is also a Bennington in Lincolnshire, but it was a southern earthquake only, as the two versions, taken together, show. It is therefore necessary to quote both of them.

In 1565 Stow wrote: "The 25 daye Maye, beying Monday, betwene the howers of eleuen and one of the clock at after noone, was an erthquake of halfe a quarter of an howre long at Blechynglye, at Godstone, at Croydon, at Alberie, & at dyuers other places in Southery & Myddlesere [Surrey and Middlesex]."

In 1580 he wrote more briefly: "The fiue and twenty of May, about nwne, was an earthquake at Blechingly, Godstone, Titsey, Rigate, Croydon, Benington, Alberie, and divers other places in Southery."

Between these dates Stow had evidently heard of more places in Surrey where the shock was felt, only two of which he mentioned, and also that it had been felt at Bennington as well as at Albury. This is of course Albury between Bennington and Bishop's Stortford, not Aldbury near Tring.

John Strype, in his 'Ecclesiastical Memorials' (1721), adds to Stow's account that this earthquake was especially felt at Dorking, but omits the Hertfordshire and some of the Surrey localities. He says: "May 25, about *Rygate, Croyden,* and *Darking* was felt an Earthquake, and especially at *Darking.* Insomuch that there, and elsewhere, Pots and Pans and Dishes fell down, and moved about."

It will be noticed that Stow, in his earlier account, states that the earthquake was felt at divers *other* places in Surrey and Middlesex, but does not name one place in the latter county, and that in his later account he omits Middlesex. Possibly he thought at first that Albury was in Middlesex, and then, finding that it was in Hertfordshire, adds Bennington as the only other place in this county where he had ascertained that it had been felt. But it seemed strange to me that a Surrey earthquake should extend into Hertfordshire without being felt in the intervening county of Middlesex and being recorded in one so populous. It was therefore a satisfaction to find that it was felt in that county. The 'Grey Friars Chronicle' supplies this information, as follows:—"Item the xxvth day of Maii, wyche was the Monday after Trenyte sonday, was gret ertheqwakes in dyuers places, as a-bowte Crowydyn and in that towne and dyuers other townes there by, as at Rygatte, and many other places a-bowte, and also at Westmyster and dyuers other places in London, and a-bowte there."

This is the only Hertfordshire earthquake of which I can find any record for the long period of five centuries, 1250 to 1750, the latter year one of great seismic activity; and of fourteen earthquake shocks which were felt in England in that year on nine days at varying periods apart, two are recorded as having been felt in our county—one on the 19th of February; the other on the 19th of March.

19*th February*, 1750.

The first of these was a violent shock felt in Italy, western France, and the Thames Valley, extending southward to Canterbury, westward to Richmond, and northward to Hertford. It was felt in London, where structural damage was done, chiefly to chimneys, about mid-day (12.40). Accounts are given in the 'Gentleman's Magazine,' the 'London Magazine,' and the 'Scots Magazine,' of the same or following month, all mentioning that the shock was felt at Hertford.

The following is an extract from the 'Gentleman's Magazine':—

"Between 12 and 1 o'clock afternoon, an earthquake was felt throughout *London* and *Westminster*; the councillors in the court of king's bench and chancery in *Westminster Hall* were so alarm'd, that they expected the building to fall; and in the new buildings about *Grosvenor Square* People ran out of their houses, the chairs shaking, and the pewter rattling on the shelves; a slaughterhouse with a hayloft over it, was thrown

down in *Southwark*, a chimney in *Leadenhall street*, and another in *Billiter Square*, several chimneys and part of a house near *Horslydown*. "On enquiry we find that the shock was felt at *Deptford*, and *Greenwich* to *Gravesend*, at *Dagnams* and *Paynesbridge*,* between *Romford* and *Brentwood*, at *Coopersale*, near *Epping*, at *Woodford*, *Walthamstow*, *Hertford*, *Highgate*, *Finchley*, —not at *Barnet*; just perceived at *Richmond* in *Surrey*, *Bromley* in *Kent*, not at *Deal*, or *Canterbury*: the news mentions it at *Calais*, and in *Italy*."

The 'London Magazine,' in mentioning Hertford, adds that the shock "was felt very much there;" and the 'Scots Magazine' adds that "the air was remarkably hazy and warm at the time."

In a communication to the Royal Society, Dr. James Parsons stated that the shock was felt "at *Stanmore*, but not at *Watford* 5 miles further."

19*th March*, 1750.

The second of these two London earthquakes was more local but more violent and prolonged. It appears to have been confined to London and its neighbourhood so far south as Epsom, and to the Lea Valley. There were three or four shocks at wide intervals between midnight and 9 a.m., and it was the last of these which affected Hertfordshire. At 5.40 a.m., in the space of from 4 to 12 seconds, there were several consecutive shocks, preceded by a loud noise compared by some to thunder, by others to the roaring of the wind, and heard by some where no shock was felt. A black cloud with continual and confused flashes of lightning had been visible, the latter ceasing a minute or two before the earthquake. Chimneys were thrown down in London and houses were injured. (Mallet, in 'Rep. Brit. Assoc.' for 1852.)

The following are extracts from the 'Gentleman's Magazine' giving an account of this earthquake:—

"This morning, at half an hour after five o'clock, the town was again alarmed with another shock of an earthquake, which is generally allowed to be more violent, and of longer continuance than that felt this day month; . . . In St. *James's Park*, and all the open places, the ground moved very perceptibly, and the noise seemed to break three times. About five o'clock, was a continual, tho' confus'd lightning, till within a minute or two of the shock being felt. . . . The dogs were sensible of it; and some of them howl'd in an uncommon manner, and fish jump'd half a yard above water.

"The shock was felt at *Cheshunt*, *Hertford*, *Ware*, *Copthall* near (not at) *Epping*, *Beckenham* in *Kent*."

A later account, by "a Member of the Royal Academy of Berlin," gives additional information:

* "Another shock was felt here, half an hour after the first."

"There was a hollow, obscure, rustling noise in the house, which ended in a loud explosion up in the air like that of a small cannon: the whole duration, from the beginning to the end of the earthquake, seemed to be about four seconds of time. The soldiers who were upon duty in *St. James's Park*, and others who were then up, saw a blackish cloud, with considerable lightning, just before the earthquake began; it was also very calm weather."

The following account of this earthquake as felt in the valley of the Lea, was communicated to the Royal Society by the Rev. William Cowper, D.D., Dean of Durham:—

"It was felt very sensibly at *Northaw*, and at *Gubbins* [Gobions], the Seat of Sir *Jeremy Seabrooke* in that Neighbourhood, whose House was shaken very much. At a Farm, three Quarters of a Mile N E of *Hatfield*, it was felt by the Farmer and his Family, but not perceived by the Inhabitants of *Hatfield* itself.

"In like manner at *Hertingfordbury*, a Village a small Mile West of *Hertford*, the Shock was felt distinctly; but not observed by any of the Inhabitants of *Hertford*.

"At my own house at *Panshanger*,* two Miles West of the above-mention'd Town, the Noise was heard twice, at the Interval of about half a minute, resembling the Rumbling of a Cart thro' the Streets; but no Shock felt either within or without-doors."

Dean Cowper adds the following account of the Aurora borealis seen between these two earthquakes:—

"I cannot help mentioning a luminous Arch, which appear'd *Feb.* 16 [27 n.s.] about 9 at Night. It had *Arcturus* in its Eastern Line, which was then low in the Horizon, and extended to the bright Star in the Shoulder of *Orion*, then bearing S W. It was exceedingly bright, regular, and well-defin'd, and about the breadth of the Rainbow; which it resembled in every thing, but its Variety of Colours. It continued thus for about 20 Minutes, declining gently Southward, and then gradually separated and disappear'd."

Dr. Stukeley, in his 'Philosophy of Earthquakes,' doubtless referring to one of Dean Cowper's informants, states this further fact with regard to this earthquake: "The gentleman who observed it about *Hertingfordbury*, says, the noise preceded the shock. And this is a common observation, which at once both strengthens our opinion of electricity, and confutes that of subterranean vapours; for, in the latter case, the concussion must precede the shock."

1*st November*, 1755.

We now come to the Great Lisbon earthquake of the 1st of November, 1755, one of the most violent and widely-extended

* The Right Hon. William Cowper, afterwards 2nd Earl Cowper, bought the Panshanger estate in 1720; his mother came from Durham.

on record. In the British Isles shocks were actually felt only in the counties of Berks, Oxford, Derby, and Cork, at one place in each county, the most violent being in the mines at Eyam Edge in Derbyshire, where they were accompanied by a loud noise in the interior of the earth, and pieces of rock fell and a long fissure was made in the ground. The sea rapidly ebbed and flowed around our coasts; the lakes of Cumberland, Westmoreland, and Central Scotland were disturbed; and ponds nearly all over England were affected. (Mallet, *loc. cit.*)*

The following "Account of the extraordinary Agitations of the Waters in several Ponds in Hertfordshire," by the Rev. T. Rutherford, Rector of Barley, was read before the Royal Society on the 1st of July, 1756:—

"I have lately had the opportunity of making some enquiries about an unusual motion of the water in a pond at Patmer-hall [Patmore Hall], which is a farm in the parish of Albury, and county of Hertford. Mr. Thomas Mott who is the occupier of the farm, tells me, that there are two ponds in his yard, which are parted from one another only by a causey, which is just wide enough to allow of a convenient passage for a waggon and driver; so that one of the ponds is to the west, and the other is to the east of it. At the western end of the former, which is the head of it, are two drains, one higher than the other, to carry off the waste water; and on each side, at the other end, close to the causeway, is a mouth, or opening, where his cattle go to drink. The pond itself is about eight roods over, and twelve roods long. The other pond is of the same size; except, that there is a dove-house in the middle of it, which stands upon a small island. On the first of November last, between ten and eleven o'clock in the forenoon, his servants, who were then close to these ponds, heard a rumbling noise, like the wind; and took notice that three ducks, which were then in the western pond, immediately flew out of it into the other, as if they were affrighted. At the same instant the water in the western pond arose at the head of it, so as to run out of the lower drain, which was ten or twelve inches above the level. He did not see this swell of the water himself; but his servants who saw it, called him immediately; and he found, that the water was then in motion; and that it had run out of the drain. It continued to move backwards and forwards for some time; but he observed, that it did not swell any more at the head, but only arose and fell at the two mouths; so that the motion was from north to south. When it arose at either of the mouths, it flowed about six feet beyond what was then the water-mark. The other pond, during the whole time, was as calm and still, as he ever saw it, unless what was occasioned by the alighting of the ducks.

* The accounts of shocks having been *felt* in Britain are disputed, it being considered doubtful whether the Lisbon earthquake produced any effect in this country except in agitating the sea, lakes, and ponds.

"Mr. Mott tells me farther, that at Wickham-hall, which is another farm, about two miles and a half from him, in the parish of Bishop-Stortford, in the same county, a pond was moved at the same time in the same manner; and that the first motion of it was from east to west. This account he had from a person, who saw it. He adds, that a like motion was observed in a pond at Thaxted, in the county of Essex; but of this he knows no particulars.

"At Royston, in the county of Hertford, Mr. Newbell, an officer of the excise, observed an unusual motion in the pond, at ten o'clock in the forenoon, November 1, last past. The pond is a large one, and almost round. The back of it, towards the north, is faced with a brick-wall; and the bottom of it arises from thence, in a slope, towards the south. The water arose from north to south, so as to go five feet and a half beyond the water-mark. In his [its] return it arose against the brick wall, the top of which was about one foot above the level of the water, so as to run over it. The water afterwards moved from north to south, and back again, five times before it stopped."

6th October, 1863.

From the date of the great Lisbon earthquake I cannot find one Hertfordshire record for more than a century, the next reported happening on the 6th of October, 1863. This was investigated by Mr. E. J. Lowe, who gave an account of it in the 'Proceedings of the British (now Royal) Meteorological Society.'

From this we learn that the earthquake was felt throughout the greater part of England and Wales, so far north as Ulverston and Scarborough, east as Bury St. Edmunds, and south-west as Hayle in Cornwall; that it also extended to Dublin and Wexford; that its greatest intensity in the British Isles was in Herefordshire and the adjoining counties; and that "there were several shocks, the two most severe close together at 3.28 a.m., the less violent ones being felt at 2.25, 3.10, and 4 a.m." About an hour (55 minutes) before its greatest intensity in England, an island was thrown up in the Mediterranean, and a shock was felt in Antigua.

Mr. Lowe remarks: "The focus of the shock must have been at a great depth, as it was felt almost simultaneously throughout England and Wales, whilst, had it been near the surface, it would have occupied 8 or 10 minutes in travelling to some of the places. The discrepancies in its estimated direction are probably owing to the vertical predominating over the horizontal movement. Near the centre of concussion, the explosion occurred immediately after the shock; but in more distant places the noise was heard *to precede* the shock, owing to the much more rapid velocity of the *sound-wave* over that of the *earth-wave*."

"At Hereford," he says, "an extraordinary sound was heard approaching from the west, accompanied by a violent shaking

of the earth: the noise was a rapid succession of detonations, not loud in its approach, but in an instant equalling thunder, and then in a moment dying away; with the crash was a fearful lift from beneath, directly upwards; many bells rang, some walls and ceilings were cracked, china and glass broken, and the trees shook violently, although the air was calm." The crash elsewhere is described as being "equal to the loudest peal of thunder, yet fuller, deeper, and grander."

In our county the principal shock was felt at Hitchin, Hemel Hempstead, and Berkhamsted. At Hitchin a house trembled and a noise like that of a passing train was heard; at Hemel Hempstead the shock was like a "swaying shiver"; at Berkhamsted the shock was only reported as "sensibly felt." Hertford is mentioned as a place where no shock was felt.

The following letter, dated "Hemel Hempstead, Tuesday, Oct. 6," and signed "H. H.," appeared in 'The Times' of the 7th:—"A slight shock of an earthquake was experienced here this morning at about 25 minutes to 4 o'clock. It lasted as near as could be calculated some 15 seconds, and made itself felt by a kind of swaying shiver. There was no undulatory motion that I could detect." (Mr. Lowe places Hemel Hempstead in Buckinghamshire.)

This is the last recorded Hertfordshire earthquake before the foundation of our Society in 1875,* and five which have occurred since then have been described in our 'Transactions.' It would be needless to repeat the accounts there given, related as fully as the information which could be collected would permit, but in order to complete our record a brief notice of these earthquakes follows. For full accounts reference must be made to our 'Transactions.'

28*th January*, 1878.

A shock which originated south of Paris, possibly under Auvergne, was felt on the 28th of January, 1878, at many places in the South of England, extending so far west as Devonshire and north as St. Albans, where it was reported by Mr. H. G. Martin, who felt "three or four distinct vibrations" about noon, the actual time probably being nearer 11.55. His letter to the Editor of the 'Herts Advertiser,' describing the shock, was reprinted in my meteorological report for 1878, a few remarks being added.

* Dr. Charles Davison, whose work on the Hereford earthquake of 1896 is the most complete account we possess of any British earthquake, has drawn my attention to the fact that as the Hereford earthquake of the 30th of October, 1868, was nearly as strong as that of the 6th of October, 1863, and originated in the same district, it "must certainly have been felt in Hertfordshire," but there does not appear to be any local record of it in our county newspapers. It extended so far to the east as Blackheath, and north-eastwards to about the centre of England, our county being well within the radius of disturbance.

22nd April, 1884.

The great Essex earthquake of the 22nd of April, 1884, spread from Colchester as its centre to Leeds on the north, Exeter on the west, and Freshwater, in the Isle of Wight, on the south; and on the south-east across the English Channel to Boulogne and Ostend. Hertfordshire was therefore well within its area, and it was felt throughout the county, almost to its extreme north at Barley and Ashwell, west at Tring, and south-east at Cheshunt. The time of its occurrence was 9.20 a.m. A full investigation of the shock and its effects was made by Messrs. Meldola and White, and published by the Essex Field Club, and Professor Meldola gave to our Society an account in which are included all Hertfordshire records, these being in great part the result of enquiries which I made for him. The effect of the shock in Essex was disastrous, over 1,200 houses and several churches having to be repaired, but in our county there was no structural damage. This earthquake, as the authors of the Essex Field Club 'Report' say, "although happily attended without loss of life, for destructiveness and wide distribution" was "without a parallel in Britain for at least four centuries." The shock was propagated over an area of about 50,000 square miles.

20th January, 1886.

An earthquake occurred in the West of England on the 20th of January, 1886. At St. Austell in Cornwall, as stated in 'The Times' of the following day, about 7 a.m. "it appeared as if an explosion had taken place, so great was the noise, and the sound was immediately followed by the shaking of the ground." At St. Blayzey, four miles distant, about 7.15 a loud rumbling noise was heard and the ground shook. The vibration lasted four or five seconds. A few minutes before 11 a.m., Dr. C. E. Shelly observed at Hertford a gasalier to be in slight but continually-tremulous vibration, in which state it continued until nearly the end of the afternoon. He contributed a brief note of the occurrence to our Society.

20th November, 1887.

A shock, at first ascribed to an earthquake, was felt on the 20th of November, 1887, in Hertfordshire and in other parts of central England, from Suffolk on the north-east to Berkshire on the south-west. On commencing an investigation of the phenomena observed to lay before our Society, Mr. H. G. Fordham determined that the shock, with its accompanying sound, "came from the air rather than from the earth," and when he heard that a luminous meteor had been seen from Hertford, he felt no doubt "that what had been attributed to an earthquake had in reality resulted from the passage, across the district affected, of a meteorite, and one probably of some magnitude." Mr. Fordham gave a full account of his

investigations in our 'Transactions' (Vol. V, pp. 33–62) with a map showing the area affected. The shock or sound, or both, resulting from the explosion of the meteorite, occurred at 8.20 a.m., and one or the other was reported from forty places in our county. Several persons mentioned "other shocks both prior to, and later than, 8.20 a.m.," and Mr. Fordham remarks: "These reports cannot be disregarded, although they can have no possible explanation in connection with the meteorite." He hints at the possibility of other meteorites having reached the earth on that morning, but leaves the explanation an open question. They must, however, be regarded as records of an earthquake the cause of which will probably never be known, but it is a curious fact which may possibly have some bearing on this phenomenon, that luminous meteors—"fiery dragons" they were at one time called—have frequently been observed at or about the time of occurrence of earthquakes.

Several shocks recorded as earthquakes in former times, which have been accompanied by a noise likened to an explosion in the air, may have been caused by the disruption of a bolide from the heat generated by friction in its passage through our atmosphere, as in the principal shock on this date.

17*th December*, 1896.

The great Hereford earthquake of the 17th of December, 1896, was felt all over Hertfordshire and recorded from a far larger number of places in the county than the greater Essex earthquake of 1884. The shock was propagated from Hereford as its centre over almost the whole of England and Wales and part of Ireland, reaching Kent on the east, Cornwall on the south-west, and the Isle of Man and Durham on the north, structural damage being done so far north as Hartlepool. It was thoroughly investigated by Dr. C. Davison, and a very complete and detailed report of its effects in Hertfordshire was given to our Society by Mr. Fordham, with a map showing the localities in the county where the shock was felt.

15*th March*, 1905.

The next earthquake recorded as having been felt in Hertfordshire, and the last one to be noticed, occurred so recently as the 15th of March, 1905. The Rev. Canon H. Trotter, of Christ Church Vicarage, Barnet, wrote in a letter of that date to 'The Times': "A sharp shock of earthquake was felt by us to-day at 1.59 p.m. We were at lunch, and some friends from India and Ceylon who were used to it were with us, confirming a fact which was plain to me. The windows and house shook, and a loud noise was heard. It lasted two or three seconds. I have since been visiting in the parish, and two persons had wondered what it was, 'as it was quite unlike the thunder, and shook the windows and floor.' My wife tells me that a lady at Hadley spoke to her of it."

Two days later, Mr. John G. Scott, of Crabgurth, Hadley Wood, wrote to 'The Times': "Referring to Canon Trotter's letter in 'The Times' of to-day, I distinctly heard a loud report like a powerful explosion, accompanied by vibration, on Wednesday last here. I looked at the clock and noted the time to be 1.58 [p.m.]. It would be interesting to know whether the cause of the disturbance was seismic, and whether it was recorded at Greenwich or elsewhere." This letter appeared in 'The Times' of 18th March.

I have recently written to Canon Trotter enquiring whether he could give me any further information about this shock, and extracts from his reply, dated 30th Dec., 1906, follow.

"We were at lunch . . . and suddenly there was a noise as of a motor-van passing close to the house, and at the same time the windows rattled and the house shook. I looked at my watch, and then, while saying 'that is an earthquake,' I carefully examined the road to see if it could have been a motor. In the afternoon I went to the Sebright Road, a quarter of a mile to the west of the Vicarage, to call on a lady. I asked her if she had noticed anything about that time, and she said, 'Oh yes, indeed!', and described almost word for word what I had experienced, the noise and the shaking. Then later in 'The Times' appeared the account of a neighbour unknown to me at Hadley Wood. This is almost due N.E. from the Vicarage, and a mile and a quarter distant. These are the facts which make me believe that it could be nothing else but an earthquake." Canon Trotter then states that there was no traffic on either road or rail (the Great Northern) which could have given rise to the noise or the shaking, and concludes: "This shock seems to have been somewhat local, but if its course were N.E., the country in that direction being very sparsely inhabited, it may easily have escaped notice."

The morning of this shock was very stormy over a great part of England, chiefly in the south. Although the area of atmospheric disturbance was wide, hurricanes and thunderstorms were local, one place here and there suffering damage, while the cyclone was but little felt in the country around. St. Albans suffered somewhat severely, while the storm was scarcely felt at Watford or at Berkhamsted, and Barnet seems to have escaped it altogether. At St. Albans, as stated in the 'Herts Advertiser' of 18th March, in the morning there had been intermittent gales, with occasional thunder and lightning; between one and two in the afternoon the sky became overspread with ominously dark clouds; and about 1.45 (within two or three minutes of that time, as I have ascertained from Mr. H. O. Carrington, who wrote the account of the storm), in the district known as Priory Park, "following a loud peal of thunder which momentarily hushed the sound of the pelting hail, a terrific crash was heard," and "fragments of wood and tiles" were seen to be "flying before the fury of the wind in all directions." The

account of this sudden hurricane occupies a column and a third of the paper, and gives graphic details of buildings being destroyed, heavy carts lifted and carried along, fences ripped up and walls blown down, tiles and slates stripped off, windows smashed, telegraph poles displaced, and trees uprooted.

Probably the first impression conveyed by the account of this hurricane at St. Albans and of the earthquake at Barnet is that the latter may have been merely a phase of the former, the clap of thunder being heard at Barnet and the rush of wind shaking the houses; but the sound could not have taken so long to reach Barnet, nor was the wind felt there. In view, however, of the very numerous instances of atmospheric and of electric disturbances accompanying earthquakes, it is difficult to resist the idea that there may have been some connection between the phenomena.

III. Earthquakes, Storms, and Auroræ.

In approaching this question we must take into consideration that earthquakes are most often due to one of the three causes mentioned at the commencement of this paper: the faulting of rocks; the sinking of strata into cavities; or explosions of steam; not one of which has any connection with atmospheric disturbances nor necessarily with electrical action. It would be enough for our argument if a sufficient number of instances were known of earthquakes being accompanied by, or immediately preceding or following, disturbances in the air or electrical discharges as in thunderstorms or that more unusual phenomenon in our latitude, the Aurora borealis, to lead to the inference that they are not merely fortuitous coincidences.

From the earliest times of which we have any record we read of earthquakes following or accompanying storms. In the Book of Exodus (xix, 16, 18) it is written, on the occasion of the giving of the Law to the Israelites: "And it came to pass on the third day in the morning, that there were thunders and lightnings, and a thick cloud upon the mount, and the voice of the trumpet exceeding loud; . . . And mount Sinai was altogether on a smoke, . . . and the smoke thereof ascended as the smoke of a furnace, and the whole mount quaked greatly." And in the 1st Book of the Kings (xix, 11) we read: "And . . . a great and strong wind rent the mountains, and brake in pieces the rocks before the Lord; . . . and after the wind an earthquake."

Though not myself doubting the historical accuracy of these passages, I may point out to any who may do so that they thereby strengthen the argument in favour of such phenomena taking place, for the Biblical writers would not have described occurrences of this kind which had not actually happened were they not familiar with them. That this belief was held by other Biblical authors is shown by poetical and imaginative writings,

for we read in the Psalms of David (lxxvii, 18): "The voice of thy thunder was in the heaven: the lightnings lightened the world: the earth trembled and shook." And in the Book of Esther (ix, 2–5), in the Apocrypha: "In the second year of the reign of Artaxerxes the Great, in the first day of the month, Nison . . . had a dream; . . . and this was his dream: Behold a noise of a tumult, with thunder, and earthquakes, and uproar in the land."

In any chronicle of the earthquakes of the world there may be found many occurrences of such phenomena as are thus described. It may suffice to give a few striking instances in chronological order, at first confining our attention to shocks which have affected the British Isles in the period covered by Mallet in his British Association Catalogue, B.C. 1606 to A.D. 1842 ('Rep. Brit. Assoc.,' 1852–54).

1. *In the British Isles.*

A.D. 681. "A great wind and earthquake in the island of Hibernia." ('Chronicum Scotorum,' 1866 ed., p. 109.)

1048, May 1. "This year also there was an earthquake, on the calends of May, in many places; at Worcester, at Wick, and at Derby; and elsewhere throughout England; . . . and the wild fire [lightning] in Derbyshire and elsewhere did much harm." ('The Saxon Chronicle,' 1623 ed., pp. 218–219.)

1234. "In whiche yere also, fyll wunderfull wether, as thunder & lyghtnynge, vnlyke vnto other, and therupon folowed an erthquake, to the greate fere of the inhabytauntes of Hutyngdon, and nere there aboute." ('The Chronicle of Fabian,' 1811 ed., p. 329.)

1274, Dec. 5. "On the vigil of St. Nicholas there were throughout England, earthquakes, lightning, thunder, a fiery dragon [luminous meteor], and a comet." (Translated from Matthew of Westminster's 'Flores Historiarum,' 1750, p. 363.*)

1361. "In that same yere was on sainct Maurys day,
The great winde and earth quake meruelous,
That greately gan the people all affraye,
So dredfull was it then and perelous,
Specially the wind was so boistous,
The stone walles, steples, houses, and trees,
Were blow doune in diuerse ferre coutrees."
('The Chronicles of John Hardyng,' 1812 ed., p. 330.)

1385. In this year there was an earthquake preceded by a great storm of thunder and lightning which struck terror into the hearts of many, some persons having been killed by the lightning. (Thomas Walsingham's 'Historia brevis,' 1574, in Latin.)

1426, Sept. 29. "On Saturday the eeuen of Saint Michaell the Archangell, in the morning before day, betwixt the houres of

* This is a more literal rendering than the only hitherto published translation.

one and two of the clocke, beganne a terrible earth-quake, with lightning and thunder, which continued the space of two houres, and was vniuersal through the worlde, so that men hadde thought the worlde as then should haue ended, and the generell doome to haue followed." (Stow's 'Annales,' 1615, p. 368.) Mallet records this as occurring throughout the whole of Great Britain, not as universal throughout the world.

So far our quaint old English chroniclers. For the next three centuries or so (up to 1750) few British earthquakes are recorded, and only two with any remarkable meteorological occurrence. One was on the 8th of January, 1704; a sudden shock in Yorkshire and Lincolnshire, preceded by a violent tempest (Mallet). The other was on the 19th of October, 1731. Of this, the Rev. J. Wasse, Rector of Aynho in Northamptonshire, says: "About a Minute after, some of the Town of Aynho saw a great Flash of Lightning. In the Morning the Sky looked of a Land-colour. It was said that there was a former Shock felt upon Oct. 8 [17 n.s.] about Three in the Morning; & that the latter was preceded by a Noise like distant Thunder." ('Phil. Trans.,' vol. xxxix, p. 367.)

We now come to a period of seismic activity unparalleled in Britain within historic times, commencing in the year 1750 and culminating with the great Lisbon earthquake of 1755, which as we have seen affected England, and Hertfordshire.

Considering shocks with an interval between them of at least an hour as separate earthquakes, there were fourteen in England in the year 1750, occurring on nine days. One was immediately preceded by continual lightning from a black cloud; another was preceded by a few hours by a thunderstorm, and at the moment of the shock a black cloud was seen; and the Aurora borealis was seen about the time of three of the earthquakes. The most severe was the one felt in London and the Home Counties on the 19th of March. There were slight shocks at midnight (18th), 2 a.m., and 3, and at 5.40 (19th) the great shock occurred in London. John Noorthouck, in his 'New History of London' (1772), says: "In St. James's Park, and all the open places, the ground moved very perceptibly, and it was observed, about 5 o'clock, that there was a continual though confused lightning, till within a minute or two of the shock, which darted very low" (p. 368). I presume he refers to the lightning as coming very near the ground. Another account, already quoted, says: "The soldiers who were upon duty in St. James Park, and others who were then up, saw a blackish cloud, with considerable lightning, just before the earthquake began." ('Hist. and Philos. of Earthquakes,' 1757, p. 243.) And another: "A little before the Earthquake, a large and black Cloud suddenly cover'd the Hemisphere." ('Phil. Trans.,' vol. xlvi, p. 644.)

On the 29th of March there was an earthquake in the South of England and the Channel Islands which is thus recorded

from Bridport, Dorsetshire: "Yesterday Morning the Sun shone very bright; which, between 11 and 12, was with dark Clouds so obscured, as render'd it darker than common. Soon after, a violent Clap of Thunder, and a heavy Shower of Hail, succeeded: After which it grew again serene; and in the Evening about 6, a Shock of an Earthquake was felt in this Town, and the neighbouring Villages, with (thro' Mercy) no other Damage than a great Surprising to all who felt it." (Nath. Downe, in 'Phil. Trans.,' vol. xlvi, p. 688.)

Flintshire, Cheshire, and Lancashire were affected by the earthquake of the 13th of April; and Thomas Pennant, the Welsh naturalist, wrote from his Seat in Flintshire: "During the Shock, a great Noise was heard in the Air; and, some Nights before, Lights were seen in the Sky: such as were previous to the Earthquake in Town." ('Phil. Trans.,' vol. xlvi, p. 687.) These lights, the Aurora borealis, were seen at the time of the shock, for the Rev. J. Seddon wrote from Liverpool: "As soon as I felt the Shock, I was immediately apprehensive what it was, and went out to see whether there was anything remarkable in the Atmosphere. I then observ'd a very uncommon appearance; *viz.* an infinite Number of Rays, proceeding from all Parts of the Heavens, converged to one Point; no luminous Body appeared at all. The Rays were at first of a bright Yellow; afterwards they became blood-red. This *Phænomenon* was not far from our *Zenith*. It continued about 20 Minutes, and then disappeared. The ensuing Night was very stormy; a large Quantity of Hail fell about Two in the Morning; and the Barometer was extremely low." ('Phil. Trans.,' vol. xlvi, pp. 697–698; see also 'Ipswich Journal,' 21 April, 1750.)

An earthquake on the 3rd of September was reported by Dr. John Green to have been, at Spalding and Newark, "attended with a loud Noise, and Crack." And he says that at the time "An *Aurora Borealis* appeared vertically, shooting Rays of all Colours round, which turned to a very deep red Colour." ('Phil. Trans.,' vol. xlvi, pp. 725–726.)

The more severe earthquake of the 11th of October, a Sunday, appears to have begun in Derbyshire, passing through the Midland Counties to Cambridgeshire. It occurred during a period of unusual atmospheric disturbances, and was accompanied by a noise variously described as "a kind of hollow noise, as loud as that of a large Cannon"; "a prodigious rolling Noise, louder than all the Thunder I ever heard in my Life," the Rev. John Nixon says; and a "Noise as of a rising rustling Wind." Mr. Nixon reported that two gentlemen, "About 6 or 7 o'Clock in the Morning before the earthquake, saw a Ball of Fire in the Air, resembling the Meteor called a falling Star; only with this difference, that the Phænomenon, after running some Space, burst into several streaming Rays, consisting of sparks of Fire, in the manner of a Sky-rocket." This was at

Peterborough, and referring to it the Rev. P. Dodderidge wrote from Northampton: "There was a Report, that, on the Morning of that *Sunday*, . . . a Ball of Fire was seen"; and he adds: "On *Monday* night the Sky in the East was as red as Blood; and, on *Tuesday* night, we had absolutely the finest *Aurora Borealis* that I remember to have seen."

Mallet states that for some time before the great earthquake of Lisbon many strange meteorological phenomena were recorded, and they followed it for about two months. On 2nd January, 1756, at Tuam in Ireland, at 4 p.m., the air being hot and very heavy, an extraordinary light was seen, which diminished insensibly after some minutes. At 7 p.m. there appeared in the atmosphere a sea of flames (*mer de flammes*), extending from east to west, lasting so for 18 minutes, then taking its course towards the north, and rapidly disappearing. At the moment of its disappearance a very violent shock of earthquake was felt, which, however, only did damage to the village of Ballymoe, some miles from Tuam. The original account of this, partly quoted by Mallet, is in a letter from Tuam in the 'Journal Encyclopédique' for 1st Feb., 1756 (tome i, pt. 3). It was most probably an unusually vivid display of the Aurora borealis, indicating great electric disturbance.

On the 24th of February, 1759, there was an earthquake, with Aurora, in Cornwall, thus described in Doddesley's 'Annual Register,' vol. ii, p. 73: "At ten at night, was felt at Leskeard [Liskeard] in Cornwall, a slight shock of an earthquake, which extended north and south six miles, and about four leagues [east] and west; it was a vibratory motion, and continued about two or three seconds. A person, apprehensive of what it was, went out to observe the air, and saw multitudes of blood-red rays converging from all parts of the heavens to one dark point, but no luminous body. The phænomenon disappeared in 15 minutes."

Mr. David Milne (afterwards Milne Home) contributed to the 'Edinburgh new Philosophical Journal' (1841–43) "Notices of Earthquake-Shocks in Great Britain, and especially in Scotland, with Inferences suggested by these Notices as to the Nature and Causes of such Shocks." A few extracts from these Notices will now be given, the pages quoted being those of a reprint which he issued in 1887.

The shock which was felt over a great part of England, on the 18th of November, 1795, extending from Leeds on the north, to Norwich on the east, and Bristol on the south-west, and which did structural damage at Derby, where twenty chimneys were shaken off, was attended with remarkable phenomena in the atmosphere, chiefly electric, and it is recorded that a "ball of fire was seen to pass over the town of Derby, when the shock was felt." There, "at the instant of the concussion," was perceived "a remarkable coruscation proceeding from the S.W. quarter of the heavens, and producing a gleam similar to a distant flash

of lightning, but of longer continuance." Many persons at Derby "felt something like an electrical shock." At Nottingham two shocks were felt and there were "luminous electric appearances in the sky." (Milne, *op. cit.*, pp. 21–22.) The passage of the meteorite may have caused some of the effects described, but when we read that there was a "motion of the earth, accompanied by a subterranean rolling noise," it would appear that Mallet, who states this, and Milne, correctly gave the occurrence a place in their catalogues as a true earthquake.

Comrie in Perthshire is more subject to seismic disturbances than any other place in the British Isles. Earthquakes occur there frequently, and earth-tremors almost daily, and sometimes several times a day. A great shock, "with a very loud noise, perhaps more so than any before," occurred on Sunday the 6th of September, 1801. On Saturday evening "the air was troubled, and apparently charged with electricity. . . . The electric fluid seemed to be waving between every cloud all over the horizon, and the whole atmosphere seemed to announce an earthquake." On the following morning there were other shocks, with "much electricity in atmosphere," and a very terrible noise. This earthquake extended much beyond the Comrie centre of seismic disturbance, structural damage being done so far away as Edinburgh. (Milne, *op. cit.*, p. 24.)

The Inverness earthquake of the 13th of August, 1816, affected almost the whole of Scotland. "At Montrose a vivid flash of lightning was observed to follow after the shock. At Dunkeld a small meteor was seen to pass from E. to W. just about the time of the earthquake." (Milne, *op. cit.*, p. 27.)

In 1833 and 1834 there were several earthquakes at Chichester and along the Hants and Dorset coast. The following notes as to them are taken from Milne's Catalogue, *op. cit.*, pp. 30–31 :—

1833, Sept. 18, at 10 a.m.: "On previous evening a brilliant aurora with meteors falling. A rushing wind heard before the shock." 1834, Jan. 23, at 2.45 a.m.: "At time of shock air was calm, but instantly after, wind rose and blew strong from S.W., with rain and lightning." 1834, Aug. 27, at 10.25 p.m.: "A whirlwind at W. of Chichester three hours previously. Appearance of sunset extraordinary, and a West India gentleman predicted an earthquake."

An earthquake, described as "the severest, unquestionably, of any which, within the memory of the oldest inhabitant, had been felt" at Comrie, occurred on the 23rd of October, 1839, at a few minutes past 10 p.m. Auroral displays were "uncommonly brilliant" about the time, at sunset on the evening of the earthquake the sky presented a most unusual appearance, the air felt warm and oppressive, and several persons who had experienced earthquakes (at Lisbon and elsewhere) remarked that the state of the atmosphere was similar to what it had been preceding those earthquakes. A remarkable sensation was felt, even by some who did not feel any shock. Immediately before the shock

there was "a sudden and violent gust of wind" with a loud rushing noise. A clergyman at Alva reported: "When I heard the noise . . . I felt very strange, and as if there was something like a shock of electricity over my body, beginning at the feet and going to the head." After the noise had passed away his chair was moved to the west and then to the east. Another clergyman at the foot of the Ochils said: "Before perceiving the shock, or thinking that an earthquake was approaching, I felt, during the continuance of the noise, as if I had been slightly electrified. A quivering sensation pervaded my whole body from the feet upwards." And an observer near Stirling said that he was "confident that it was accompanied with an electric shock." He did not hear any noise, although the shock was violent. (Milne, *op. cit.*, pp. 106–165.)

2. *In other parts of the World.*

If instead of taking British earthquakes only, those of the world were considered, such instances as the above of aerial disturbances accompanying them might be multiplied ten-fold, and much more striking ones might be given. A few only will be very briefly mentioned as examples.

For the four nights of 23rd to 26th December, 1755, within two months of the great Lisbon earthquake, a reddish light resembling the flames of a volcano was seen from a village at the foot of the Pyrenees, lasting for some hours each night and making the atmosphere hot. When disappearing on the last display, just before 3 a.m. on the 27th, the sky became covered with a dense cloud; a subterranean noise was heard, lasting half a minute; in another half minute an earthquake shock was felt, lasting the same time; and similar noises and shocks succeeded each other, usually at increasing intervals, and becoming gradually feebler, for six times, up to 5 a.m. ('Journ. Encycl.,' t. i, pp. 128–129.)

On the same night, but earlier—a few minutes past midnight—in the region of the Lower Rhine, the heavens appeared as if all on fire, and at the same time a similar succession of dull noises and earthquake shocks commenced, continuing until about 2 a.m., and recurring at 4 a.m. (Mallet's Catalogue.)

The electric energy which these auroral displays evince was still more pronounced, a little later, in Belgium, in a series of earthquakes which commenced on the 20th of February, 1756. During the most violent shocks lightning was observed, auroræ were frequently seen, and some persons "felt a sensation like that of a strong electric shock." (Mallet, *loc. cit.*)

Humboldt in his 'Travels' gives a graphic account of strange phenomena attending an earthquake at Cumana, in Venezuela, in 1799. From 28th October to 3rd November a dense red mist covered the sky, which appeared as if on fire, and the air felt much hotter than the actual temperature warranted. On 4th November, about 2 p.m., large clouds of extraordinary

blackness enveloped the mountains, gradually extending to the zenith. About 4 p.m., thunder was heard at an immense height overhead, and at the moment of the strongest electric explosion, at 4.12, there were two earthquake shocks with an interval of 15 seconds between them, the first being preceded by a very violent blast of wind followed by electrical rain falling in great drops.

As these earthquakes were not very severe ones, Mallet's brief account, from one of Perrey's Memoirs, may be quoted as an example of a more disastrous and more recent convulsion.

1837, Sept. 22, 3 a.m. Van Dieman's Land and New Holland. "Violent and disastrous earthquake, which continued until dawn. The sea made inroads upon the shore, and a new island was formed. On the evening of the 21st, terrible explosions were heard at Lasaya, and long luminous streaks of bright red were seen on the horizon, the whole sky then became of the same colour. During the earthquake the surface of the ground was in motion like that of the waves of the sea, while every five minutes the explosions became terrible. The atmosphere was heavy, and was lit up by flashes of lightning. Lasaya and Maya were thrown down and filled with corpses. A terrible tempest at the same time."

We may be thankful that such a catastrophe as this is not likely to occur in our country, and I think we should be convinced that the aerial disturbances which so often accompany earthquakes are not always mere coincidences.

3. *Recent Records.*

It may perhaps be objected that all these are old records, and that we have, therefore, no means of verifying them. The last British earthquake, which occurred during tempestuous weather, seems to have been accompanied by a display of electric energy somewhat different from a thunderstorm. The following account of it appeared in the 'Morning Post' of the 4th of January, 1907:—

"Earth tremors varying in intensity were felt on Wednesday night (2nd) in the higher parts of Newport, Monmouthshire. A loud, rumbling noise at a quarter to eleven o'clock was followed by a distinct movement of the earth and the violent shaking of windows, some of which were broken. A quarter of an hour later there was another but less severe shock. The tremors were registered on scientific instruments in the town, and were distinctly felt by many persons; children were frightened as they lay in bed, and others complained of a feeling of sickness. Some persons state that the rumbling was followed by flashes as of lightning, and so extraordinary was the noise that residents left their houses in alarm to ascertain whether their neighbours had been similarly disturbed."

The expression "flashes as of lightning" is very suggestive in

connection with the unusual electric displays which it will have been seen have accompanied so many earthquakes.*

Whilst engaged in collecting old records which might tend to show some relation between seismic disturbances and storms such as that which preceded the earthquake at Barnet, I received the issue of the 'Meteorological Magazine' for the 17th of January, 1907. In it is a paper by Mr. William Gaw of Santiago on "Atmospheric Phenomena during the Chile Earthquake." The author states that the Meteorological Section of the Direction of Marine Territory "prognosticated some atmospheric or seismic disturbances for the day" on which the earthquake commenced, the 16th of August, 1906, stating that "the dangerous circle passes Valparaiso," and it was here that the shocks were most violent. The prediction was founded upon astronomical events, and might have been made years beforehand.

The shocks commenced at about 8 p.m and continued at various intervals until 5 a.m. the following day, numbering twenty-three. Copious rain fell for some hours before the first shock and continued until about 10 p.m. The severest and most destructive shock was the second, at 8 h. 7 m. 30 s. p.m. on the 16th. "At the moment of the catastrophe the heavens presented a most unnatural hue. Electrical discharges were numerous, and it seemed as if the sober laws of physics had revolted." By the 20th, 106 shocks had been recorded by the seismograph at Santiago.

From the data brought forward by the author he deduced:

"(1) The third and second days previous to the great shocks were characterized by a high barometer accompanied with rain—abnormal conditions here. (2) The day preceding the first seismic movement (15th) was marked by a sudden fall of about half-an-inch of barometric pressure in a comparatively short period of time."

Upon these facts he made the following suggestive remarks:—

"The cause and import of such a fluctuation is perhaps difficult to determine, but the writer is of opinion that there was some relation between the earthquake of the 16th and the atmospheric phenomena observed before and after it. He is also convinced that there is interesting and instructive information to be acquired by carefully observing all atmospheric phenomena that precede seismic movements all over the globe. That there is *some* relation between atmospheric perturbations and seismic tremors few will deny; and it may not be too much to anticipate that in future observers in meteorology will play

* That the magnetic needle is frequently disturbed during an earthquake is well known. On the 19th of January, 1845, during an earthquake in the West Indies, the compasses on a Thames steamer revolved with great rapidity; and on the 29th of October, 1867, while one of the West India islands (St. Thomas) was being shaken by an earthquake, and a hurricane was raging, the electrical disturbance was so great as to render the compasses temporarily unavailable.

their part in contributing data that will help to determine the genesis of seismic phenomena. Until we possess a more perfect knowledge of the physical conditions existing a few miles beneath the Earth's crust, we should be content to be tentative and not dogmatic in our assertions."

(Whilst this paper was being passed through the press Dr. C. Davison has informed me that a doctor who was at Valparaiso at that time told him that "a curious light played along the tops of the mountains at the time of the earthquake." This light is referred to in the Twelfth Report of the Seismological Committee of the British Association, where the following occurs:— "Accounts of luminosity in the heavens or on hills at the time of large earthquakes are common. One of the last occasions upon which phenomena of this nature were observed was at the time of the Valparaiso earthquake, August 17th, 1906," when "there appeared upon the hills at a height of about 500 metres waves of light. These waves, which are compared to chain lightning, extended as far as the eye could reach, and lasted during the first shock, or nearly two minutes. On these occasions strong earth-currents have affected the working of land lines, and needles of galvanometers have been disturbed."

Dr. John Milne, Secretary of the Seismological Committee, noticed that a quarry in the Isle of Wight, known as Pan Chalk Pit, appeared from time to time to be luminous. This induced him to carry on a series of experiments in the hope of throwing some light upon the subject. He found that bromide photographic paper placed underground in the chalk and carefully excluded from light was at times curiously affected as by light, while it was not so affected in the same apparatus when above the ground, and he was led to make the suggestion that the markings "may result from very feeble brush or glow-light electrical discharge. If this be so," he says, "it would also account for the bands on the photographic paper, the other markings being due to minute sparks."* Thus it would appear, as he infers, that there are radio-active or electrical emanations from our earth. Of sixty-three earthquakes recorded by his seismograph at Shide during these experiments, only ten nearly coincided with the times of occurrence of spots upon the paper, and he regarded these coincidences as accidental. A probable cause is therefore disclosed of certain luminous phenomena sometimes observed during earthquakes, although these experiments have not resulted in any connection being traced between them.)

IV. Conclusion.

Electricity is merely a form of energy inseparable from matter. Some even attribute to it the origin of matter. Produced as it can be by friction, it may be converted into

* The Report of the Seismological Committee, giving a full account of the experiments, will appear in the Report of the British Association for 1907.

heat, and it is so converted when it meets with a certain amount of resistance. It is known that electric currents are constantly traversing the earth at no great distance from the surface, and it does not seem unlikely that such currents may meet with resistance and so may generate heat having an expansive force sufficient to cause at least a tremor on the surface. In fact, it seems to be within the bounds of possibility that the meeting of currents of positive and negative electricity may cause a subterranean thunderstorm. The frequent occurrence during earthquakes of electric storms of various kinds, such as thunderstorms, auroral displays, "flashes as of lightning," and the appearance of "a sea of fire," tend to show such a reaction between the heavens and the earth as may warrant the supposition of a common origin for the disturbed state of the atmosphere, especially acute at St. Albans, and the slight earth tremors with accompanying noise at Barnet and Hadley, on the 15th of March, 1905.

Earthquakes have occurred in Hertfordshire, it will be seen from the preceding record, in every month from September to May, but not in any of the three summer months, June to August. This fact is not without significance, for whether we take the British Isles only, or the whole of the northern hemisphere, it will be found that they are considerably more numerous in winter than in summer, and those which occur in winter are usually more severe than those which occur in summer; in other words there is in the colder season greater seismic activity both as to frequency and force. David Milne gave a table (*op. cit.*, p. 53) in which he showed that of the 255 British earthquakes of known dates recorded up to October, 1839, there occurred in the first quarter of the year 74, in the second 44, in the third 58, and in the fourth 79. He called these periods winter, spring, summer, and autumn. Calculating from his table the distribution in each season of the year, commencing the spring with March and ending the winter with February, the usual meteorological division of the seasons, it appears that there were 53, or 21 %, in the spring; 44, or 17 %, in the summer; 84, or 33 %, in the autumn; and 74, or 29 %, in the winter. Robert Mallet, in his fourth and last Report to the British Association "On the Facts and Theory of Earthquake Phenomena," gave a table showing the monthly distribution of all earthquakes of known dates up to the end of the year 1850, from which it appears that there were 5879 in the northern hemisphere thus distributed over the seasons of the year: spring, 1430, or 24½ %; summer, 1331, or 23 %; autumn, 1452, or 24½ %; and winter, 1666, or 28 %; summer thus having much the smallest number, and winter much the largest. So few earthquakes have been recorded in the southern hemisphere that their inclusion would not make any appreciable difference to the seasonal distribution, but it is evident that they ought not to be included, as the seasons there are reversed.

Many more earthquakes are recorded as having occurred during the night than during the day, but this may be due, as Dr. John Milne has suggested, to the fact that slight shocks which would pass unnoticed in the daytime would be felt by people in bed. Four in Hertfordshire have been felt between 3 and 6 a.m., and five between 9 and noon; all between 3 a.m. and 2 p.m. That this does not accord with the general rule is probably an accidental circumstance or partly due to the length of time taken in their transmission, a few having occurred at their point of origin long before they were felt in our county.

A few words should be said about erroneous records, some of which have given me much trouble to unravel.

Two Herefordshire earthquakes, one in March, 1755, the other on 27th December, 1768, have been attributed to Hertfordshire. The error as to both of these was made by Alexis Perrey in his list of British earthquakes (1850). Fortunately he gave his authorities—for the first the 'Collection Académique' (1761), where the following occurs :—"1755, Mars, les montagnes du Comté de Hereford en Angleterre furent ébranlées et bouleversées"; for the second the 'Mercure de France' (1760), where, after an account of an earthquake in the counties of Worcester and Gloucester on 21st December, 1768, is the statement: "Le 27, on a senti une nouvelle secousse dans le comté de Herford," evidently from the context a mistake for Hereford. The first of these errors has been copied by Mallet (1753), O'Reilly (1885 and 1886), and Roper (1889), in their earthquake catalogues. The date of the earthquake of 13th December, 1250, is given by Holinshed (1577) and Prestwich (1870) as the 10th. Lowe (1870) gave two dates for one earthquake. Perrey confused the two earthquakes of 19th and 29th March, 1750, giving Hertfordshire localities for the later one, and the error has been copied by Mallet and Roper. And Meldola and White, in their account of the great Essex earthquake (1884), attributed one to Hertfordshire on 8th March, 1750, and another on 19th, the former date being the old style of reckoning and the latter the new style for the same day. In the present paper the new style has always been given, except in quotations, when the new style has been added in brackets.

Three Hertfordshire earthquakes, those on 19th February, 1750, 1st November, 1755, and 28th January, 1878, were caused by pulsations transmitted from abroad; three, those on 6th October, 1863, 20th January, 1886, and 17th December, 1896, came to us from the west of England; and three, those on 25th May, 1551, 19th March, 1750, and 22nd April, 1884, originated in the south-east of England, the first in Surrey, the second in London, and the third in Essex. The point of origin of the first one named as being abroad may have been in the English Channel, as it was felt at the same time in London as in Normandy, Picardy, and Brittany. Our county is only responsible for two, the earliest, on 13th December, 1250, and

the latest, on 15th March, 1905; while the point of origin of the slight shocks on 20th November, 1887, is uncertain.

Not far beneath us, probably nearer the surface in the Valley of the Lea than here, but even there some thousand feet down, is a ridge of rocks of Palæozoic age, consisting of Wenlock Shale dipping southwards at a high angle, of Upper Devonian beds dipping at a smaller angle, and of red rocks which may be either Old or New Red Sandstone or Carboniferous, with about the same dip. This ridge is believed to run nearly east and west, and if so would transmit earthquake shocks to us on the one hand from the volcanic districts of the Continent of Europe, and on the other from strata liable to faulting which form the rather insecure groundwork of Herefordshire and the surrounding district.

We are thus as it were between two fires, but the Cretaceous and Eocene beds which lie upon the rigid Palæozoic rocks are of such a yielding nature that they would form a kind of buffer to a deep-seated shock, and although it is on record that the bed of the River Thames was so far upheaved or the flow of water so much held back by an earthquake in 1158 that it was walked over dry-shod in London, it is unlikely that we shall ever experience in Hertfordshire or Middlesex such a shock as that which John Hardyng witnessed in England in 1382, when

> "Th earth quake was whiche that tyme I sawe,
> That castelles, walles, toures, and steples fyll,
> Houses and trees and cragges fro the hyll."

V. Appendix.

1. *List of Earthquakes recorded in Hertfordshire, with references to the Bibliography which follows.*

1250, Dec. 13.—St. Albans and the Chilterns: *Matthew* (1567), *Paris* (1571), *Holinshed* (1577), *Stow* (1580), *Cambridge* (1750), *Anon.—Hist. Rev.* (1752), *Anon.—Hist. Ver.* (1815), *Williams* (1822), *Perrey* (1850), *Mallet* (1853), *Lowe* (1870), *Prestwich* (1870), *O'Reilly* (1885, 1886), *Roper* (1889).

1551, May 25.—Albury: *Stow* (1565); Bennington and Albury: *Stow* (1580), *Stowe* and *Howes* (1615).

1750, Feb. 19.—Hertford: *Gent. Mag.* (1750), *Lond. Mag.* (1750), *Scots Mag.* (1750), *Milne* (1841), *Meldola* and *White* (1885), *O'Reilly* (1885, 1886), *Home* (1887), *Roper* (1889).

1750, March 19.—Northaw, Gobions, near Hatfield, Panshanger, Hertingfordbury, Hertford, Ware, and Cheshunt: *Cowper* (1750), *Stukeley* (1750), *Cambridge* (1750), *Gent. Mag.* (1750), *Scots Mag.* (1750), *Milne* (1841), *Perrey* (1850), *Mallet* (1853), *Lowe* (1870), *Meldola* and *White* (1885), *O'Reilly* (1885, 1886), *Meldola* (1886), *Home* (1887), *Roper* (1889).

1755, Nov. 1.—Royston, Albury, and near Bishop's Stortford (Patmore Hall and Wickham Hall): *Rutherford* (1756), *Perrey* (1850), *Mallet* (1853), *Meldola* (1886).

1863, Oct. 6.—Hitchin, Hemel Hempstead, and Berkhamsted: *Lowe* (1864), *Perrey* (1865).

1878, Jan. 28.—St. Albans: *Hopkinson* (1879).

1884, April 22.—Royston, Ashwell, Tring, King's Langley, St. Albans, Barley, Buntingford, Throcking, Bishop's Stortford, Hertford, Ware, and Cheshunt: *Symons* (1884), *Chateaubrun* (1884), *Ragg* (1884), *Topley* (1884), *Meldola* (1884, 1886), *Harvey* (1885), *Meldola* and *White* (1885).

1886, Jan. 20.—Hertford: *Shelly* (1887).

1887, Nov. 20.—Several places in Herts: *Fordham* (1888).

1896, Dec. 17.—General over the county; recorded at 50 places: *Symons* (1897), *Fordham* (1897), *Davison* (1899).

1905, March 15.—Barnet and Hadley: *Hopkinson* (1908).

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XV.

ADDRESS.

THE MYSTERY OF MATTER.

By the President, JOHN MORISON, M.D., D.P.H., M.R.C.S., F.G.S.

Delivered at the Anniversary Meeting at Watford, 12th March, 1907.

LADIES AND GENTLEMEN,—

We are surrounded by mysteries we cannot penetrate. Our own conscious life, nay our very existence, is an inscrutable mystery. The little about the Universe which the wisest man can know and understand, is incomparably small when set against the much which man does not know and perhaps can never grasp. Sir Isaac Newton said that he felt like a child collecting shells on the sea-shore, while the great ocean of Truth lay all undiscovered before him. And though much has been discovered since Newton's time, we can still say that what we do know is like a tiny drop in comparison with the vast sea of the unknown. There is the Mystery of Life; the Mystery of Space; the Mystery of Time and Eternity, etc. But one of the chief amongst them is the mystery which environs us and enfolds us and forms the very framework of our being, the Mystery of Matter.

Recent investigations and discoveries have enabled us to penetrate this mystery to some slight extent, though very much still remains dark and veiled and perhaps unknowable. On this subject I wish to say a few words to-night, though I can only give a very brief and imperfect sketch of some of these recent researches and discoveries.

The astronomer has to study bodies of almost inconceivable magnitude, and to range through almost infinite distances, but I must ask you to-night to view with the eyes of the mind objects of such unthinkable minuteness that they would have to be magnified many millions of times to render them visible in the most powerful microscope. Science has to deal with the infinitely little as well as with the infinitely great.

I can only treat the subject in a very general way, and you will have to accept a great many of my statements on trust, as it is impossible for me to enter into detail as to the manner in which they have been proved and verified.

The question of the constitution and structure of matter is one which lies deep down at the very foundation of all knowledge,

and has from a remote antiquity stimulated the curiosity and exercised the minds of all thinking men. Amongst the earliest theories and speculations which have come down to us, are those of some of the ancient Greek philosophers, such as Democritus and Anaxagoras, who may be taken as representatives of two entirely different schools of thought. Some of the Hindoo philosophers also meditated and speculated on the subject, amongst them Kabir, who lived in the fifteenth century of our era. He denied that matter had any real existence, and affirmed that it was simply an illusion of the senses. He held that spirit was the only reality. For our own country Bishop Berkeley, in the early part of the eighteenth century, promulgated a somewhat similar creed, namely, that matter apart from sensation did not really and actually exist. But most of us will be disposed to agree with Lord Byron, who says, somewhat crudely, though forcibly:

"When Bishop Berkeley said there was no matter
And proved it—'twas no matter what he said."

At any rate, I will assume that matter is an objective reality.

Now when we consider the various phenomena of the Universe—dive down, so to speak, to the very foundation of everything—we find that there are not more than three essential verities or entities underlying all things. Leaving out Mind and Thought, which we may consider not material, also Time and Space, which we may look upon as conditions but not actual things, those three essential realities are Matter, Energy, and the luminiferous Ether. Matter may be defined as something which occupies space, and is characterized by inertia. It possesses mass and weight, and is more or less evident to our senses. The ether is believed to fill all space, so far at any rate as our universe is concerned, and it permeates all material things. It is not in itself evident to our senses, but is only known to us through the vibrations or waves which pass through it and which constitute light, heat, and other forms of energy. It is considered to be a fluid perfectly homogeneous and without parts. Energy may be defined as essentially motion. It may be motion of matter in mass; motion of the minute particles of which matter is composed; or it may consist of waves or vibrations in the Ether. It is of several different kinds, such as mechanical energy, light, heat, electricity, magnetism; all capable of being transformed into each other. More briefly, matter may be defined as that which is moved or acted upon; energy as that which moves or acts; and the ether as the medium through

which the action is conveyed. All these three things—matter, the ether, and energy—have been thought to be, under present conditions at least, uncreatable and indestructible. But whether this is so or not is somewhat doubtful, for energy in the form of light and heat radiated from the Sun and stars is constantly being dissipated into space, and the phenomena of radio-activity seem to render the absolute permanence of matter more or less questionable.

A certain number of physicists believe that there are only two fundamental verities or entities; some holding with Professor J. J. Thomson that matter is really identical with electricity or energy; others like Lord Kelvin that the ultimate particles of matter are of the nature of vortices or whirls in the Ether, and are really separated portions of ether rotating with inconceivable rapidity; while others again consider the ether to be simply a very highly rarefied and tenuous form of matter. But we shall take it for granted that there are three distinct and fundamental realities underlying all things—Matter, Energy, and the Ether.

I have said that matter is especially characterized by what is called inertia. This means that matter continues in its state of rest or motion, whichever it may be, unless it be interfered with by some force acting upon it from without. This applies especially to matter in mass. Thus a body remains at rest until it is caused to move by some external force, and when caused to move would continue to move on at the same rate of speed for ever, unless retarded and stopped by something outside itself. Thus a bullet discharged from a rifle would go on travelling at the same speed to all eternity, unless it were acted on by the friction of the air and the attraction of the earth.

We cannot create or destroy matter: we can transform it or change its shape, but do what we will the amount of matter in the universe remains exactly the same. Matter is impenetrable, that is to say, no two portions of matter can occupy the same place at the same time; but it is also porous, that is, even in the densest and most apparently continuous forms of matter, such as the heavier metals, the ultimate particles of which it is composed are separated from each other by fairly wide interspaces, and these interspaces are occupied by ether. And in some cases the spaces between the particles may be partly filled up by particles of another kind of matter. The absorption of gases by charcoal, and the absorption of hydrogen gas by the metal palladium, are instances of this. And particles of one kind of matter may pass through the spaces which separate the

particles of another kind of matter. Thus gases may pass through unglazed pottery or heated iron.

When we try to look into the real nature of matter, one of the first things to strike us is that it must either be infinitely divisible or that there must be a limit to its divisibility. Anaxagoras and some of the old Greek philosophers took the former view, that matter could be divided ad infinitum, and that after any number of divisions, no final particle could ever be arrived at which had not two halves, and was not capable of subdivision into smaller pieces. I may mention that this theory is quite incapable of explaining the observed phenomena. Democritus with other old Greek thinkers, on the other hand, held that matter was not infinitely divisible, but that it was composed of ultimate particles which he called atoms, and which were eternal, uncreatable, and indestructible. This atomic hypothesis was afterwards adopted by the famous Roman philosopher-poet Lucretius, and treated at length by him in his great work 'De Rerum Natura.' It was revived in modern times, and finally assumed a definite shape as the "Atomic Theory" of John Dalton, the celebrated chemist and physicist, and was promulgated by him at the beginning of the nineteenth century. And the years which have elapsed since Dalton's time have only served to confirm the essential truth of his theory, though recent investigations and discoveries have tended materially to modify its details.

The essence of the "Atomic Theory" as held in recent years is that substances are not homogeneous and infinitely divisible, but are composed of ultimate particles. Those particles differ in size and character in different substances, and have been called molecules. A molecule may be defined as the smallest portion of a substance which can exist as such, possessing the distinctive properties of that substance. Molecules are built up of still smaller particles called atoms. In simple or what we call elementary bodies such as oxygen, hydrogen, sulphur, and iron, the atoms which compose a molecule are all of one kind. In compound bodies, which are composed of two or more elements, the molecules are composed of two or more different kinds of atoms; and the molecules of organic compounds are often exceedingly complex, and many of them may contain hundreds of atoms of several different kinds. A simple body or an element is a substance which can not be decomposed into simpler substances by any process at present known to Chemists; and a compound body is composed of two or more simple bodies.

Chemists recognize some 80 or more elements, which combine with each other in certain definite and unvarying proportions. Thus two parts or atoms of hydrogen combine with one part of oxygen to form a molecule of water. From these combining proportions what are called the atomic weights of the elements have been deduced, that is, the proportional weights of the different atoms. These atomic weights vary very much, ranging from hydrogen, which is represented by 1, to uranium, which is designated as 238; an atom of uranium being 238 times as heavy as an atom of hydrogen. The specific gravities or densities of the elements, though greater in elements with high atomic weights, do not regularly increase with increase in the weight of the atoms, showing us that some atoms must be heavier or more massive in proportion to their size than others. Atoms have been supposed to be indivisible and indestructible, but recent discoveries have tended materially to modify our opinion on these points. Atoms combine with each other to form molecules, and molecules are the smallest portions of any substance which can exist as such.

Molecules and atoms are all exceedingly minute. It has been calculated that a cubic centimetre of air contains 21 trillions of molecules, and that it takes 10 trillions of molecules of air (10 millions of millions of millions) to make a milligramme; and that a milligramme of hydrogen would contain 144 trillions of molecules; so that their minuteness is absolutely beyond all conception. The diameter of a molecule of gold has been calculated not to exceed the five millionth part of a millimetre, and it may be considerably less. The smallest organic speck, which is visible in the most powerful microscope, is in diameter about the four thousandth part of a millimetre, and it is considered that such a speck contains at least two millions of organic molecules, which, as we have seen, are much larger and more complex than molecules of an inorganic nature. And such a tiny speck must contain at least one hundred millions of atoms. All molecules and atoms of the same substance are exactly similar to each other in every respect.

Molecules even in a solid body are not in contact, but are situated at some distance from each other, the intervening spaces being occupied by ether. They are continually oscillating to and fro in very rapid motion, each molecule having, so to speak, its own orbit of motion. If we apply heat to a solid body, such as a crystal of some salt, we get first an increase in the motion of the component molecules, causing elevation of temperature;

next, when this increase becomes considerable, at a temperature which varies in different substances, the molecules begin to move more rapidly, and to leave their own special spheres, and move freely amongst each other. Then the solid becomes a liquid. Still continuing to apply heat, the separation of the molecules becomes much more considerable, the rate and extent of their motion much greater, and they are continually jostling against each other. In other words, the liquid is converted into a gas. The motion of the molecules in gases is exceedingly rapid. Clavering has calculated that the molecules of air move at the rate of 485 miles a second, and that the rate of motion of hydrogen molecules is no less than 1,844 miles a second. The molecules are continually striking against each other and against the sides of any vessel which may contain the gas. It has been calculated that a molecule of air under ordinary atmospheric pressure and at a temperature of 32° F. strikes another molecule no less than 4,700 million times a second.

Not only are the molecules constantly in motion, but the atoms which compose them are continually vibrating to and fro with extreme rapidity, and this vibration becomes more and more rapid as the temperature increases. Sometimes with the application of heat, the atomic motion becomes so greatly increased that the equilibrium of the molecules is destroyed, and the atom from one kind of molecule passes into the sphere of another kind of molecule, but what is known as chemical action comes into operation, new combinations of atoms or new molecules are formed, and new chemical compounds are the result. Thus, if in the presence of air we apply a light to a jet of coal-gas, which is mainly composed of carbon and hydrogen, the molecules of the gas in contact with the light are heated, become unstable, and undergo dissolution. The same thing occurs to the heated molecules of oxygen in the air. Then the free atoms of oxygen, carbon, and hydrogen mix with each other and enter into new combinations, forming molecules of carbon dioxide and water.

Thus we find that matter is composed and built up of exceedingly small particles called molecules, differing in character in different substances; that molecules are made up of one, two, or more minute bodies called atoms, which also differ in character in the various elementary bodies; that the molecules of compounds are composed of atoms of two or more different kinds; that both molecules and atoms are immersed in and separated by a perfectly homogeneous fluid known as the ether; and that both atoms and molecules are continually moving to and fro with

extreme rapidity, the velocity of motion increasing as the temperature rises. We also note that in solid bodies the molecules are comparatively close together and their sphere of motion is limited; that in liquids they move amongst each other to some extent and their sphere of motion is increased; and that in gases the molecules are very much further apart, and their rate of motion becomes very much more rapid, while they dash amongst each other in all directions, constantly striking against each other and against the walls of any vessel containing them. We must also bear in mind that the intramolecular motion of the atoms becomes greatly accelerated in gases.

Until very recently it was almost universally believed that atoms were simple and indivisible specks of matter.

Soon after the time of Dalton, early in the 19th century, it was noticed that the atomic weights of most of the elementary bodies were very nearly exact multiples of the weight of the atom of hydrogen, the element which has the lowest atomic weight. And Prout tried to show that hydrogen was really the primordial substance which lay at the root of all matter, and that all the various elements really consisted of different combinations of the hydrogen atom. This view was also supported by Dumas the celebrated French chemist. It was soon shown, however, by more accurate determinations, that the atomic weights of very few of the elements were anything like exact multiples of the atomic weight of hydrogen, and this hypothesis necessarily fell to the ground. Professor Wurtz, of Paris, some 30 years ago or more, suggested that possibly the hydrogen atom was composed of about ten or more sub-atoms; and that these sub-atoms by different combinations and in varying proportions built up the atoms of all the other elements; so that we might look upon all matter as fundamentally the same, the different atoms being all composed and made up of sub-atoms exactly similar to each other.

But recent discoveries have revealed to us that matter is very much more complex still, and in the light of the present day we have learned not only that atoms can no longer be looked upon as indivisible, but that, on the contrary, each atom is built up of thousands of still more minute particles. We have also found that atoms are not indestructible, for it has been shown that the atoms of at least some elements may undergo dissolution, and that the sub-atoms and particles which they contain may enter into new combinations, and build up new atoms of entirely different elements. Thus the leading idea of the old Alchemists

that it was possible for one element to be changed into another, has been amply justified, though we have not yet succeeded in changing lead into gold. And we can hardly consider that matter is really eternal, for many things tend to show that at some remote period in the far-off past it may have had a beginning, and that some time in the dim and distant future, when numberless æons have come and gone, it may have an end. Yet even so we cannot doubt that an infinity of universes may have existed before ours came into being, and that after the present Scheme of Things has at length ceased to be, an infinite number of fresh creations may follow. The whole history of our universe, past, present, and future, can be only a drop in the ocean of eternity.

Let us now review the various steps which led to the discovery of the complexity of constitution of the atom. And first let us consider what is called the ionisation of a gas. Under ordinary circumstances gases are usually very slight conductors of electricity, but under certain conditions their conductivity may be greatly increased. The mere presence of uranium, radium, and some other substances, make the air more conductible. The air in the neighbourhood of a flame or a piece of white-hot metal, is also rendered more conductible. This is well shown by means of a charged electroscope. An electroscope may be made by attaching a strip of gold-leaf to an insulated brass column. If this apparatus be electrified or charged with electricity, the electrical repulsion between two bodies similarly charged causes the gold-leaf to stand out from the column at an angle varying in magnitude according to the amount of electrification. If such a charged electroscope be brought near a lighted candle it is at once discharged and the gold-leaf falls down against the column. This is evidently due to some change having taken place in the constitution of the gases surrounding the candle which renders them more conductible. It has been shown that this change is due to the presence of electrified particles or ions emitted by the flame, some charged with negative and some with positive electricity. A low temperature and high pressure are favourable to the production of positive ions, while a high temperature and low pressure favour the formation of negative ions.

Let us take the negative ions first. They have also been called electrons or corpuscles. They are inconceivably minute bodies shot off from flames, from glowing metals or carbon, from metals under the impact of ultra-violet light; and they

are also produced under various other conditions. They travel at a most astounding rate of speed, and their velocity varies according to the conditions under which they are emitted. Their speed may be taken to be from 10,000 to 90,000 miles a second. At the latter rate they would travel round the earth more than three times in one second. The mass of a corpuscle is small beyond conception: it has been calculated not to exceed $\frac{1}{1000}$ part of the mass of a hydrogen atom. A beam of corpuscles is bent by a magnetic force acting at right angles to its path. The corpuscles cause phosphorescence in bodies which they strike; they raise the temperature of substances which they strike; and they communicate mechanical motion to bodies against which they impinge. From whatever source the corpuscles are derived they are all exactly similar to each other in every respect, and they constitute actual parts of the matter from which they are emitted.

The positive ions, on the other hand, are of atomic dimensions, comparable in size to a hydrogen or helium atom, perhaps 2,000 or 3,000 times as large as the negative ions. They carry a charge of positive electricity; are very slightly deflected or bent by magnetism; and their velocity is very much less than that of the negative corpuscles.

Let us consider next the phenomena which accompany electrical discharges in high vacua. When a discharge passes through the air at ordinary atmospheric pressure, a narrow spark is seen to flash between the electrodes of the electrical machine; but when the electrodes are placed in an air-tight receptacle, and the air withdrawn by means of a mercurial air-pump, the spark becomes broader and more ill-defined as the pressure is reduced. If a cylindrical glass or vacuum-tube be used and the pressure be reduced to $\frac{1}{200}$ of an atmosphere, a glow of light is seen to spread out from the electrodes and to fill the tube. This glow is mostly reddish in colour, but surrounding the negative electrode, or cathode as it is called, there is a blue glow. When the exhaustion is carried still further, until the pressure is reduced to no more than $\frac{1}{10000}$ part of an atmosphere, a patch of green fluorescent light is seen on the side of the tube opposite the negative electrode. Faint streaks of blue luminosity are seen stretching from the cathode to this phosphorescent spot, and these faint streaks have received the name of the cathode rays. These rays are very penetrating and will pass through thin plates of metal. They are absorbed by all substances inversely in proportion to the density of each

substance. They are bent by a magnet. They consist of negatively electrified particles, each about $\frac{1}{1000}$ part the size of a hydrogen atom, and they move with the velocity of 20,000 to 60,000 miles a second. In fact, they are in every respect identical with the negative ions or corpuscles mentioned before. When these rays of corpuscles are suddenly arrested, either by impinging on the glass of the tube, or still more effectively by striking a metal plate, they give rise to the well-known X or Röntgen rays, which are not corpuscular, but are due to peculiar vibrations or pulses in the ether. The Röntgen rays have a remarkable power of penetrating solid matter which is opaque to ordinary light.

We get positive rays also from the anode or positive electrode. They are much fainter and more inconspicuous than the cathode rays, and move comparatively slowly. They have been called the anode or canal rays. They are slightly deflected by a magnet in the opposite direction to the cathode rays. They consist of positively electrified particles, and are of atomic dimensions, comparable in size to an atom of hydrogen or helium. These positive ions are not all exactly similar to each other, like the negative ions or corpuscles, but vary to some extent according to the source from which they are derived. J. J. Thomson considers that they are "atoms or groups of atoms from which one or more corpuscles have been removed."

Corpuscles or negative ions are produced under many different conditions. All substances which are heated evolve them to some extent. When metals and some other substances are exposed to light, corpuscles are emitted. We can detect their emission from some substances, such as lithium and an alloy of potassium and sodium, even when cold. And there is reason to suppose that all substances emit them to some extent. Corpuscles are produced in large quantities when salts are put into flame. They are continually being formed in very great numbers and emitted with very great velocities by certain bodies which are called radio-active. And according to J. J. Thomson there is good reason to suppose that corpuscles reach us from the sun. Their distribution is therefore very wide, and they appear to form part of all kinds of matter under all sorts of conditions. From whatever source they may be derived, they seem to be always exactly similar to each other.

Now let us deal with radio-activity and radio-active bodies.

When the X rays were discovered in 1896 it was at first supposed that the luminescence or phosphorescence of the glass

of the vacuum-tube, due to the impact of the cathode rays, was a condition necessary to the production of the X rays. But it was found later that when cathode rays impinged on a plate of metal, more especially a heavy metal like platinum, although no phosphorescence appeared, yet Röntgen rays of a specially penetrating character were produced. This idea that phosphorescence was the cause of X rays, though erroneous, led indirectly to discoveries of the greatest importance. To it was due the epoch-making discovery of radio-activity and radium.

Professor Henri Becquerel of Paris was experimenting with various bodies which became phosphorescent after exposure to sunlight in order to see if they emitted X rays, when it occurred to him to try a salt of the rare metal uranium. He took some uranium salt, wrapped it well up in black paper, and placed it on a prepared photographic plate, with a layer of metal foil between the plate and the salt. He wrapped up the whole in black paper and put it in a dark place for 24 hours. He then examined the plate and found it "fogged" as if acted on by light. He next tried some uranium salt prepared in the dark, which had never been exposed to light at all, keeping it wrapped up in the same way for 24 hours, and found the result to be the same. This was evidently due to the formation and emission by the uranium of penetrating rays under ordinary conditions. These rays from uranium were found to be composed of streams of corpuscles. They have been called Becquerel rays, from the name of the discoverer. The property of emitting these rays is called radio-activity, and the substances possessing it are said to be radio-active. Crooks then showed that the radiation was mainly due to a substance present in the uranium which he called uranium X. Then M. Curie, whose untimely death last year was so great a loss to science, and Madame Sklowdowski Curie his talented wife, took up the subject and discovered that the mineral pitch-blende, which is an oxide of uranium mixed with various other metallic compounds, was several times more radio-active than uranium itself. It was thus evident that the pitch-blende contained small quantities of some other substance much more active than uranium. By a very elaborate process M. and Madame Curie managed to separate out two new radio-active substances, one of which they named polonium, and the other, much the more active of the two, they called radium.

The radio-active elements, that is, those which are known to emit corpuscular rays, are uranium, thorium, actinium, and radium. Several others have been thought to occur, but either

their existence is not well established, or they appear, like polonium for instance, to be derivation-products of one of the four radio-active elements I have mentioned. Radium appears to be the most active of these bodies; indeed, Professor Rutherford estimates its energy to be no less than three million times the energy of uranium. All these radio-active elements have very high atomic weights, and it has been thought that the comparatively large size and complexity of constitution of their atoms may render them specially unstable. The atomic weight of radium is estimated to be about 225. The element itself has never been isolated: we know it only in the form of its salts, such as the chloride or bromide. When we speak of radium it must be understood that its salts are meant. Radium is phosphorescent in the dark, and is continually emitting rays of a peculiarly penetrating character; and it is also constantly giving out energy in the form of heat. The heat which it emits is sufficient to keep its temperature permanently raised 5° F. above the temperature of surrounding objects. It has been estimated that one gramme of radium would melt its own weight of ice in one hour and would continue to do so every hour for at least 1,300 years. The rays proceeding from radium have great power of penetration. If a glass tube containing a mere speck of a radium salt be allowed to touch the forehead a sensation of light will be produced. This is due to the rays from radium passing through the glass, through skin, bone, and other tissues, impinging on the retina, and rendering it phosphorescent. There are various chemical effects produced by the radium rays. If a radium salt be dissolved in water, the water is continually though slowly decomposed into its elementary constituents, oxygen and hydrogen, which are evolved in minute bubbles. The radium rays act on a photographic plate in the same manner as light. The physiological effects of radium are very powerful. Becquerel carried a small piece of a radium salt in his waistcoat pocket for a short time. The skin under the pocket became inflamed, and a painful sore developed, which healed with great difficulty. According to Strutt cases have been reported where the action of radium has resulted in the reduction of cancer growths. He also says that the rays seem to retard the growth of bacteria under certain circumstances and that they destroy the leaves of plants.

The rays which proceed from radium are of at least three different kinds, which have been called the α, β, and γ rays. The α rays have comparatively little penetrating power, they

are slightly bent by magnetism and travel at the approximate rate of 12,000 miles a second. They consist of particles about the size of an atom of ordinary matter; indeed, they are generally considered to be free atoms of helium. They carry a small charge of positive electricity, and are considered to be identical with the positive ions described before. The heating effect of radium seems to be mainly due to the α rays, and is produced by the constant bombardment of the molecules of radium by its own α particles. The β rays are very different. They are composed of exceedingly minute particles about $\frac{1}{1000}$ part the size of a hydrogen atom, and are emitted with the extreme velocity of over 120,000 miles a second. At this rate they would travel from the earth to the moon in 2 seconds, or from the earth to the sun, 93 millions of miles, in something like 13 minutes. They travel no less than half a million times as fast as a cannon-ball. They are easily bent or deflected by magnetism in the opposite direction to the α rays; they carry a charge of negative electricity; and they are much more penetrating than the α rays. The photographic action of radium is principally due to the β corpuscles, which appear to be identical with the negative ions before mentioned.

To give some idea of the exceeding minuteness of these tiny bodies, let us imagine a collection of α particles and β corpuscles the size of a drop of water, and let us suppose this collection to be magnified to about the size of the earth, a globe having a diameter of 8,000 miles; we should then see the α particles about the size of small shot, while the β corpuscles would still remain much too small for the naked eye to distinguish.

The γ rays are much the most penetrating of all. They are not composed of particles, but are due to peculiar vibrations or pulses in the ether. They never occur when β rays are absent, and are believed to be caused by the sudden arrest of the motion of the β corpuscles.

The radium rays have the property of exciting fluorescence or phosphorescence in various substances (such as sulphate of zinc, for example) which may be placed close to a radium salt. This is produced by the bombardment of the α particles. A little instrument called a spinthariscope has been devised to show this. It is also well seen when a radium salt is mixed with sulphide of zinc and painted on a cardboard screen, when it will glow perpetually in the dark. If such a screen be examined through a lens in a darkened room, an immense number of tiny scintillations can constantly be seen. Radium has also the property of

exciting temporary radio-activity in substances placed near it, and this activity remains for some little time after the removal of the radium. The explanation of this I will give presently.

But we have not half exhausted all the wonders of radium. Still greater marvels remain.

Besides the emission of rays, radium is continually being transformed into other substances, giving birth indeed to a whole series of what we may look upon as separate and distinct elements. A heavy gas is constantly being given off from radium which has been called the "radium emanation." A small quantity of emanation is always escaping from a radium compound in its ordinary state, but it is emitted much more freely when the radium is dissolved or heated. This shows that a piece of radium salt in its usual condition contains a good deal of emanation shut up in its interstices, which is liberated on the solution or heating of the radium. This emanation is a radio-active gas of heavy atomic weight allied to the recently discovered inert gases which exist in the atmosphere, such as argon, helium, and neon. Radium itself, on the contrary, is allied to barium, calcium, and the alkaline-earth group of metals. The emanation is intensely radio-active, and with its decomposition-products to be noticed later is responsible for three-fourths of the activity and heat manifested by radium. It has a definite spectrum of bright lines analogous to that of argon. It is really a distinct element, but is not permanent, continually undergoing change. Its atom is much more unstable than that of radium, and breaks up at such a rate that one half of the emanation is transformed into another substance in about four days. It is brilliantly phosphorescent. Its activity is simply enormous, being about 100,000 times greater than that of radium. Its transformation is accompanied by the emission of α particles, and is attended by an enormous evolution of heat: the heat evolved being at least one million times greater than that produced by any chemical reaction known. Radium itself, freed from the emanation and its subsequent products, emits only α rays; while its activity and heating effect immediately after the emanation is removed is reduced to only one-quarter of its usual value. But fresh emanation continues to be formed, and so the activity of the radium continues to increase until it reaches its normal amount, which occurs in about a month.

The emanation in its turn is transformed into a solid substance called by Rutherford the "active deposit." All

bodies in contact with the radium emanation become coated with a thin film of this deposit, and this is the cause of the temporary radio-activity which radium excites in bodies close to it. The deposit is intensely radio-active, and possesses distinguishing physical and chemical properties.

Ramsay and Soddy have shown that in the course of the transformation of the emanation helium is produced. They introduced some pure emanation into a vacuum-tube, and after five days the complete spectrum of helium was observed. As I have said, it is generally believed that the α particles are free atoms of helium.

Helium was first discovered in the spectrum of the Sun by Janssen and Lockyer. A bright yellow line was noticed different from that of any known element. Helium was afterwards found to be one of the mono-atomic inert gases which are present in small quantities in the atmosphere, and has also been shown to exist in pitch-blende and other minerals from which radium can be extracted. We may therefore look upon it as at any rate a bye-product of the transformation of radium.

The active deposit is much more radio-active even than the radium emanation. The small quantity which is present in a piece of radium is responsible for about half of the activity manifested. It consists essentially of a mixture of three distinct substances, which have been called radium A, radium B, and radium C. These three products are formed by three successive disintegrations of the atom. The emanation is first transformed into radium A with the emission of an α particle, and radium A is exceedingly unstable, having an average life of only three minutes. Emitting an α particle it is quickly transformed into radium B. Radium B emits no rays: it has a period of about 26 minutes, and is transformed into radium C. Radium C has a period of 19 minutes and is transformed into a comparatively stable substance. The atom of radium C breaks up with explosive energy, emitting α, β, and γ rays. The α rays travel much faster than those from any other radium product, and the β corpuscles are emitted with a speed approaching the velocity of light. A piece of ordinary radium contains stored within it small quantities of the emanation, of radium A, radium B, and radium C, and the activity which it manifests proceeds not only from the radium itself, but also from its transformation-products. These three transformations have been called collectively the active deposit of rapid change. The transformations of radium do not come to an end with radium C, but continue through three more

distinct and successive stages. A body which has been exposed to the radium emanation does not completely lose its activity an hour after it has been removed from the vicinity of the radium, though the activity which remains is exceedingly small, being after that time, according to Rutherford, less than one millionth of that observed immediately after removal. This small residual activity was first observed by Madame Curie. It is at a minimum at first and continues to increase as time goes on. The activity comprises both α and β rays, the latter being present in a greater proportion than is observed in radium and the active deposit of rapid change. The α rays reach a maximum in about 240 days, and the β rays after about 50 days. After this time the radiation appears to continue without marked alteration for a lengthened period. Professor Rutherford's investigations have shown that this residual activity is caused by three more successive transformations of the radium product, which he has termed collectively the active deposit of slow change. The three stages have been called radium D, radium E, and radium F. Radium D is produced by the transformation of radium C. It emits no rays, is a comparatively stable body, and has been calculated to have a period of about 40 years, but this of course is only an approximative estimate. It is considered by Rutherford to be identical with the so-called radio-lead, first separated by Hofmann from pitch-blende residues. Radium D is slowly transformed into radium E, which has a comparatively short life, being half transformed in about six days; radium E emits only β and γ rays, and in its turn is changed into radium F, which emits only α rays and has a period of 143 days. There is good reason to think that radium F is identical with the radio-tellurium of Marckwald and with the polonium which was separated from pitch-blende by M. and Madame Curie. Radium F, after emitting an α particle, is converted into the final product, which, so far as we can tell, appears to be stable.

All these different radium products are really to be looked upon as totally distinct though temporary elements, with different physical and chemical properties, and different atomic constitutions. It has been calculated that the total period of existence of a radium atom cannot on the average exceed a few thousand years. Therefore, all the radium now existing on the earth must have come into being within a comparatively recent period, and will cease to exist as such at no extremely distant date. So we appear to be drawn to the conclusion that radium is constantly being formed, and is derived from the transformation

of some other element, and that it is itself as constantly being transformed into some more stable elementary substance. Rutherford is strongly of opinion that uranium is the parent substance from which radium is derived. Uranium itself emits only α rays; it is transformed into uranium X, which emits only β and γ rays; and uranium X is transformed into what seems to be a rayless product. Rutherford thinks that uranium X probably undergoes one or more further changes of a long period, possibly rayless in character, and is finally transformed into radium. Rutherford also considers that the final product into which radium changes is probably lead. He mentions in corroboration of his views that uranium and radium are always associated together in the minerals which contain them in certain definite and unvarying proportions, and that lead is always associated with radio-active minerals, especially such as are rich in uranium. It is important to note that some of the radium transformation-products are rayless; that is to say, they are transformed into other substances without any evidence of the emission of α or β particles. This may be explained in two different ways. First we may consider that the transformation consists in a re-arrangement of the component parts of the atom to form a new temporarily stable system. On the other hypothesis we may suppose the transformation to be similar in character to the change which is accompanied by the emission of α rays; the only difference being that the α particles, although emitted with great speed, do not travel with a velocity sufficient to cause appreciable ionisation of the gases through which they pass, and so escape observation. Rutherford seems to consider the latter explanation to be the more probable.

Each of the other radio-active elements, thorium and actinium, passes through a series of somewhat similar changes. Rutherford, however, considers that actinium is not in itself radio-active, but that the activity which it manifests is entirely due to its decomposition-products, and he also thinks that the radio-activity of pure thorium when freed from its transformation-products is very doubtful.

Thorium is one of the rarer elements, and is found in thorite (a silicate of thorium) and various other minerals. Its oxide thorin is the principal constituent of the Welsbach gas-mantles used for lighting purposes. The activity of thorium is much the same as that of uranium in amount. An interesting experiment may be made by splitting up a Welsbach mantle and placing it on a prepared photographic plate, wrapping up the

plate and mantle in a dark cloth, and depositing the whole in a dark place for eight days. When taken out the plate will be found to have a photograph of the mantle imprinted upon it. The mantle, indeed, has photographed itself by means of its own thorium rays.

According to Hahn's investigations, thorium, which in itself is rayless, is continually undergoing change into a substance which he calls radio-thorium. Radio-thorium emits α rays and is changed into thorium X, which in its turn, with the emission of an α particle, is transformed into the thorium emanation. This emanation is very like that of radium, but its life is much shorter, being half transformed in 54 seconds. It has been shown to be a heavy inert gas of high atomic weight. Like the radium emanation, with the emission of an α particle, it is changed into an active deposit. This active deposit is a mixture of two substances, thorium A and thorium B. The emanation is first converted into thorium A, which is a rayless product, and is soon changed into thorium B; then thorium B breaks up, violently emitting α, β, and γ rays, and is transformed into a substance which is apparently stable.

Actinium is a very rare element which was discovered by Debierne in pitch-blende residues. It seems to be nearly equal to radium in activity. It has not yet been separated in a state sufficiently isolated to allow of the determination of its atomic weight or spectrum. According to Hahn, actinium, in itself rayless, is continually giving rise to a substance which he calls radio-actinium, which with the emission of an α particle is changed into actinium X; then actinium X, emitting another α particle, is converted into an emanation like that of thorium, but still more short-lived, being half transformed in 3 or 4 seconds. The active deposit, like that of thorium, is a mixture of two substances, actinium A and actinium B. The emanation, with the emission of an α particle, becomes actinium A, a rayless body; actinium A is soon changed into actinium B; and actinium B, emitting α, β, and γ rays, is quickly transformed into a substance which appears to be stable.

Traces of radium or radio-active bodies are found in most rocks, in the soil, in rain and snow, in the atmosphere, indeed very generally over the earth's surface. Radium is found in more considerable quantity in the deposits from certain thermal springs such as those of Bath and Buxton. The waters of these springs not only contain small quantities of radium or its products, but also traces of helium.

Professor Joly, of Dublin, suggests the startling hypothesis that the radium emanation in the earth's atmosphere may be directly derived from the sun.

There is good reason to think that ordinary matter is to some extent radio-active, and if so must be slowly though surely undergoing change. Strutt says we have a million-fold descent in radio-activity when passing from radium to uranium, and it is at least possible that some ordinary substances may possess an activity of their own, apart from radio-active impurities, which is much more than a millionth part of that of uranium. Campbell claims to have obtained evidence that ordinary matter possesses the property of emitting ionising radiations, and that each element emits radiations differing both in character and intensity. Rutherford says that if the expulsion of an α particle be taken as evidence of atomic disintegration, calculation shows that the life of ordinary matter must be regarded as at least one thousand times that of uranium. But he also remarks that it is by no means necessary to suppose that the transformation of matter should always be accompanied by the intense effects exhibited by the radio-active bodies; for that ordinary matter might be emitting α particles at a rate comparable to that of uranium, but that if their speed was too low to produce sensible ionisation it would be difficult to detect their presence.

M. Gustave Le Bon, in an article published in the 'Athenæum' of 17th November, 1906, says that all bodies possess the property of radio-activity under certain conditions. He cites as an example mercury, which is not appreciably radio-active in its ordinary state, but he says that if a few millimetres of its weight of tin be added to it, it becomes forty times more active than uranium. In the same article he says that "all bodies contain an immense reservoir of energy shut up within them from the time of their formation." He thinks that the atoms of bodies are of very different ages, and that the tendency of any atom to disintegration is simply a consequence of old age. He considers that the incandescence of the sun and stars and the greater part of the forces of the universe are due to the liberation of the intra-atomic energy which accompanies what he calls the "dematerialisation of matter." Some of his conclusions are: "Matter formerly supposed indestructible is slowly fading away by the continual dissociation of the atoms of which it is composed." "Energy and matter are two different forms of the same thing. Matter represents a stable form of intra-atomic

energy. Heat, light, electricity, etc., represent unstable forms of the same energy." "In dissociating atoms, that is to say, in dematerialising matter, one only transforms the stable form of energy named matter into those unstable forms known as electricity, heat, light, etc. Matter is then continually being transformed into energy." Most of us will not, I think, be inclined to go quite so far as M. Le Bon.

Let us go over the principal points.

We have seen that matter is built up of molecules, and that molecules are composed of one, two, or more atoms. In monoatomic bodies the molecule and atom are identical, but in most cases the molecule is composed of at least two atoms, while in organic compounds the atoms composing the molecule may be very numerous. The atoms vary very considerably in size and mass, the heaviest atoms being nearly 240 times as massive as the smallest, but they are all excessively minute. The diameter of the smallest, the hydrogen atom, is estimated not to exceed the one fifty millionth of an inch. Both molecules and atoms are immersed in and surrounded by a perfectly homogeneous fluid called the ether. The atoms are made up of a great number of almost infinitely small bodies which have been called corpuscles. The diameter of a corpuscle is not more than the one hundred thousandth part of the diameter of a hydrogen atom, so that its exceeding minuteness is absolutely inconceivable. In other words, the length of one inch exceeds the diameter of a corpuscle in about the same proportion as the distance separating the Earth from the Sun (some 93 millions of miles) is greater than one inch. The corpuscles are very sparsely distributed within the atom, being separated in proportion to their size by relatively enormous distances, the intervening spaces being filled by ether. Sir Oliver Lodge says that if we imagine an atom of hydrogen magnified to the size of an ordinary church the corpuscles would appear about the size of grains of sand dashing about and rotating round the interior with inconceivable velocity. Strutt says that the corpuscles in an atom are separated from each other by distances as great in proportion to their size as those which separate the different planets in the Solar System from each other. The corpuscles are continually revolving round the centre of the atom with absolutely inconceivable rapidity. The ether in which the corpuscles are immersed is positively electrified, constantly vibrating, that is to say, in one special manner, while the corpuscles being negatively electrified are continually vibrating in a different way. The corpuscles in

the atom of any element are exactly similar in every respect to each other, and to the corpuscles in the atom of any other element, so that the fundamental basis of all matter is the same. The special radio-active elements, radium, uranium, etc., have the largest and most complex atoms, and Rutherford considers it probable that they are made up of sub-atoms identical with the atom of helium, and that one of these sub-atoms is expelled as an α particle at nearly every radio-active change. These sub-atoms or α particles within the radium atom are in continuous very rapid movement, and when a stage of instability is reached one of them is expelled from the atom with the velocity which it possessed in its atomic orbit. He also thinks it possible that hydrogen as well as helium may prove to be one of the more elementary units of which the heavier atoms are built up. Professor J. J. Thomson considers that the cause of the disintegration of the atoms of radium is the loss of energy by radiation from the atom.

We see, then, that the atom, far from being simple and indivisible, is really a very complicated structure. And as both the α and β particles are expelled from it with such tremendous force, we can understand what inconceivable stores of energy are locked up in the atom. And the excessively tiny corpuscles which compose it are really the basis of everything. The various forms of matter which occur throughout the Universe, solid, liquid, or gaseous, organic and inorganic, are all composed and built up of these inconceivably minute corpuscles. The enormous energy with which the corpuscles are endowed one would think must have had a beginning, and in process of time must come to an end. Whether these tiny bodies are indeed material specks, and possess inherent mass, or whether they are really separated portions of the ether, and their apparent mass is simply due to the inconceivable energy with which they are gifted, is perhaps an open question, though I incline to the latter view. But it is absolutely certain that energy is their all-important characteristic; and without energy matter as such would cease to exist. And we have seen that the atoms of matter are not permanent, but that some of them at any rate are constantly undergoing change: each change being attended by an emission of energy. And we know that the energy of the Universe is being slowly dissipated into space. So that matter on the whole must be continually losing energy. As at some remote period in the far-off æons past it had a beginning, so perhaps untold ages hence, not only all material things, but matter itself as such, unless it be re-energised, must finally come to an end.

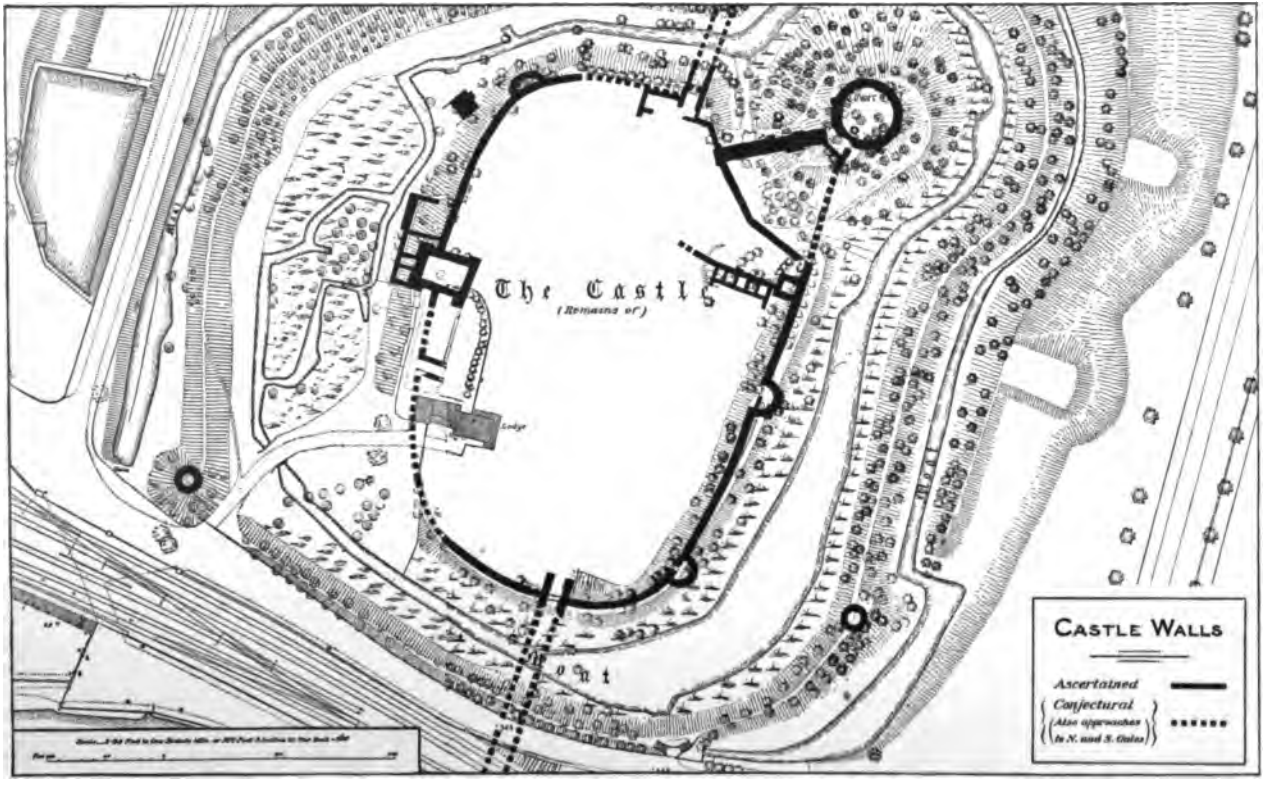
In the words of an anonymous minor poet:

"Even the solid earth we tread
Must some day lie cold and dead,
And the strong Sun's glowing might,
Source of all our life and light,
Must at length grow dark and cold,
And the myriad stars which burn
Through the Universe untold
Must to nothingness return."

Energy could not create itself; there must be something behind and beyond, some stupendous Power who inspired it at the beginning, Who breathed into dead matter the breath of life. And the Power who at the first bestowed the energy can re-impart it, and transform or re-create a dying world or universe. We are told there is to be a new heaven and a new earth. It is also impossible to conceive that the countless myriads of myriads of corpuscles, infinitesimal specks all exactly similar to each other in every respect, and endowed with such boundless possibilities, should have come into existence by accident, or that they could have made themselves. We must perforce acknowledge that they must all have been formed by one and the same Creative Intelligence, and that this Creative Intelligence must of necessity be Almighty and Eternal. Thus the latest teachings of Science all tend to strengthen our belief and confirm our faith in the Divine Creator "who formed all things by the word of His power," and "in Whom we live and move and have our being."

One thing more: as energy forms the basis of the material universe, and as one of the most conspicuous forms of energy is light, we read with added meaning those grand old words which stand at the beginning of the book of Genesis:

"In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of the deep. . . . And God said, Let there be light, and there was light."



PLAN OF BERKHAMSTED CASTLE WITH THE WALLS RESTORED.

XVI.

NOTES ON BERKHAMSTED CASTLE.

By Duncan Montgomerie.

Read at Berkhamsted, 7th July, 1906.

(Communicated by Edward Mawley, V.M.H., etc.)

(PLATES VIII and IX.)

The first detailed description of this Castle was that made by the late Mr. G. T. Clark and incorporated into Cobb's 'History of Berkhamsted,' but the plan given is an inaccurate one and some of the conclusions at which Mr. Clark arrived have been found to be incorrect.

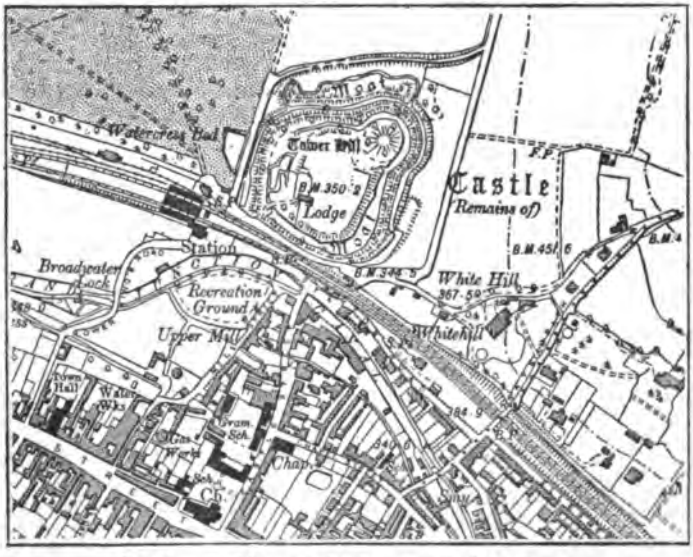


Fig. 5.—*Berkhamsted Castle and part of the Town.*
Scale: 6 inches to the mile.

The earthworks of the Castle represent the original Norman fortress founded by William the Conqueror, and the original appellation of a "burh" has been proved to be fallacious. A Saxon "burh," or "burg," was always a fortified town, whereas the moated mound of Berkhamsted, in common with similar ones at Hertford, Bishop's Stortford, Anstey, Bennington, and Pirton, are of the type of castle introduced by the Normans into England and known as "mottes," or from their shape, as "mount and bailey castles."

Large numbers of these exist all over England and Wales, and in Normandy and in those parts of Scotland and Ireland into which the Normans penetrated.

It is somewhat disappointing, no doubt, to be told that banks and ditches represent the "Castle," where one had imagined a frowning tower of stone, but the earthworks now seen are the original, if less imposing, Fortress.

In the reign of Henry II, the famous Thomas à Becket was granted the custody of Berkhamsted Castle, and it appears from the records that he replaced the old wooden defences, stockades, palisades, and wooden towers, with which the banks were crowned, by the walls of flint-rubble which still partly surround the enclosure.

Excavations have been undertaken during the past three years, under the original auspices of Mr. William Page, F.S.A., and Rev. Canon Norman, F.R.S., and carried on by myself, to uncover, so far as possible, the masonry defences and works now in ruins and partly buried beneath the soil.*

Taking the chief discoveries in order, we have:

1. The south gate, towards the town. This was found to be flanked by two solid towers of flint-rubble, with a passage-way of about 11 feet; only a yard or so of each tower was left above the original foundation, but their shape was traceable.

The ditches were evidently crossed by wooden bridges, with moveable portions, known as drawbridges. The two fragments of wall visible on the outer bank may have formed part of a half-way tower, from which probably the drawbridges were worked, one on each side.

When standing in the south gate it will be observed how Castle Street points to it from the town.

2. In the two large gaps in the east wall may be traced the footings of two half-round towers for flanking that wall. These were closed at the back with a thin wall, and in the northern one were found traces of steps leading to a small cellar or basement.

3. At the north end of this east wall, and along the south side of the detached cross-wall, were found a number of chambers of varying sizes and construction, and it is probable that the Great Hall, the centre of life in the Castle, lies somewhere in this quarter.

4. Crossing over to the western side, we come to the most massive remains of any, and there was here uncovered a large rectangular building, projecting, as may now be seen, into the inner ward, but also outwards beyond the "curtain-wall," as the main wall of the Castle is termed. In front of this building, and down towards the moat, were found three large

* A history of the Castle, with a large plan, giving further results of the excavations, will appear in the second volume of the 'Victoria History of the County of Hertford,' shortly to be issued.

cellars, of later date than the Castle itself, and containing large quantities of bones, shells, and other kitchen-rubbish, and also several encaustic tiles having various patterns, heraldic and otherwise.

The purpose of this large building is not at all clear, for there does not seem to be any entrance to it, except a small flight of steps on the north side. It may have been the Great Chapel, but the remains are too ruinous for us to ascertain its uses.

5. Proceeding now towards the great mound, it may be mentioned that just at the north-east corner of the north curtain-wall, where it begins to curve round towards the detached wall, was found the Derne Gate or Postern ("derne" meaning secret), and this led by means of bridges across the moat to the country beyond, affording a very convenient means of slipping out of the Castle, unobserved from the town.

6. The moat originally completely surrounded the mound, and was only filled in about thirty years ago to make the latter more accessible. The great mass of wall seen running up the mound formerly joined the detached piece on the side of the inner ward, but was gradually broken through and destroyed. It crossed the moat by an arch and was eleven feet wide, carrying a flight of steps leading to the Keep, and protected on the outer side by a parapet wall. There was a similar but thinner wall on the east, now gone, and the two thus connected the Keep with the rest of the masonry defences, but without preventing the separate defence of the former.

7. Ascending the great mound we find a circular platform on the top, and around it are the remains of a thick rubble wall. This was the "shell keep," which formed a large circular tower, not roofed over, but containing various chambers, offices, etc., and one of the rooms is referred to as the King's Chamber, showing that in those days safety was preferred to comfort, for the Keep was small compared with the roomy ward below.

A well, lined with excellent masonry, was discovered near the edge of the Keep towards the south-west side, so that the defence was independent of the rest of the Castle.

In the year 1216 the Castle sustained a siege by Louis of France and his adherent barons, fresh from the capture of Hertford Castle, and after a spirited defence it was obliged to surrender owing to the terrific bombardment from a number of large siege-engines, which hurled, according to the account by Roger of Wendover, "damnosos lapides" with such deadly aim that the garrison yielded.

8. With reference to these engines it may be mentioned that on the extreme outer bank, next to the road on the north, are seen certain large banks or mounds of earth, which were called "bastions" by Mr. Clark, but which appear to have no relation to the original earthwork defences, and Mr. St. John Hope has pointed out that these most certainly represent the platforms

thrown up by the besiegers to carry their great engines, and if anyone cares to examine them, it will be found that they are very suitable for this purpose; the majority point straight to the Keep, and they all have a slight slope to the front, as though to suit a particular type of siege-engine. They could easily have been thrown up under cover of the bank, while archers, lining that, kept down the fire from the Castle.

Before leaving the neighbourhood of the mound it may be stated that by running a deep trench round the inner edge of the ditch of the old mound, the footings of the curtain-wall along that edge were discovered, facing the Keep.

The excavations have allowed of a complete plan being made of the principal masonry defences, so far as they exist (Plates VIII and IX), and it is to be hoped that future work may show something of the internal arrangements.

A few miscellaneous remarks on the Castle follow.

The triple ditches and double banks are very unusual; similar, but less perfect, arrangements exist at Wallingford, Berks, and at Whittington, Salop.

At the south-west and south-east corners of the middle bank are mounds intended to carry a tower to flank the long line of bank.

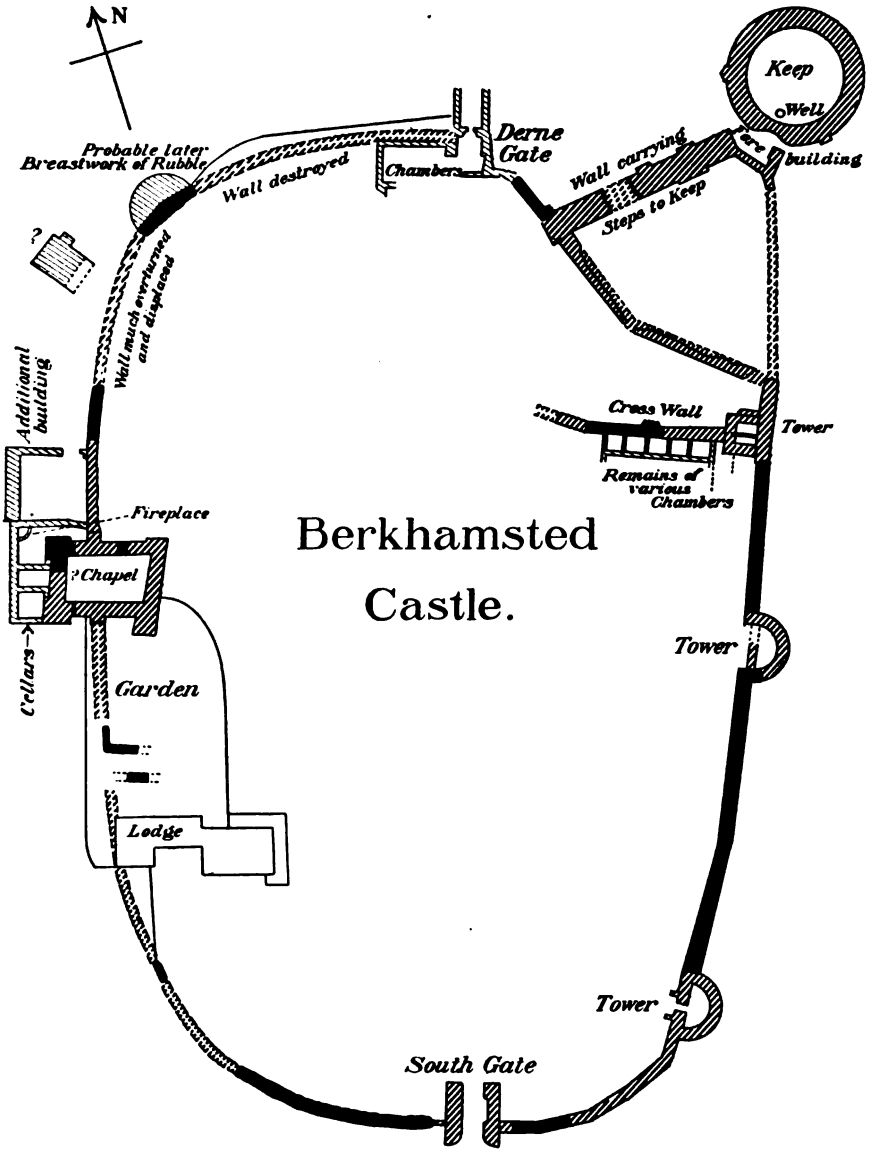
The big watercress-bed on the west, and the trace of a dry ditch to the north of it, represent an earth barbican covering the "great gate of the Castle upon the west." The exact position of this gate has not been determined, but it may lie hidden under the garden of the lodge.

The small square projection on the north-west, beyond the curtain, seems to have been the foot of a tower whose base was level with the waters of the moat, but as all was ruinous except about four feet of wall, the exact function of this is obscure. Some tiles were found here, of a later date than those of the "Chapel."

The great width of moat on the south-west and south-east, forming a *stagnum* or lake, should be observed.

The ground south of the Castle, so far as the Bulbourne, formerly a considerable stream, was at one time a swamp.

I would like to add a few words on the subject of ivy and the destruction it produces in old buildings. Its evil effects are especially visible at Berkhamsted, and I have noticed much disintegration besides that due to wet, frost, and small boys. At the south-east corner of the Castle there is a flagrant case of approaching ruin where a big ivy-trunk, growing in the thickness of the wall, is about to split off its entire face. Ivy may be very interesting from certain points of view, but when it destroys, disintegrates, and conceals priceless old buildings and ruins, it is a noxious weed and should be treated as such.



PLAN OF THE WALLS OF BERKHAMSTED CASTLE.

XVII.

NOTES ON LEPIDOPTERA OBSERVED IN HERTFORDSHIRE IN THE YEAR 1906.

By A. E. Gibbs, F.L.S., F.E.S., F.R.H.S.

Read at Watford, 23rd April, 1907.

I am glad to be able to add two species of Lepidoptera to our county list, both reported by Mr. P. J. Barraud, F.E.S., of Bushey Heath. They are:—

1. *Oxyptilia pilosellæ*, a plume-moth of which five specimens were taken by Mr. T. F. Furnival on the Canal banks near Tring Station, on 13th August, 1905. Mr. Furnival is now abroad, but before leaving the country he presented his collection of Lepidoptera to Mr. Barraud, and it is only recently that the identification of this little moth has been confirmed by Dr. T. A. Chapman. Mr. Barraud informs me that Mr. T. A. Court, of Market Rasen, Lincolnshire, was with Mr. Furnival at the time the capture was made, and he also took some specimens. Although this is not a record for the past year, it is satisfactory to be able to make the addition to the local list.

2. *Gelechia diffinis*, one of the Tineina, taken at light by Mr. Barraud at Bushey Heath.

The season of 1906, although it commenced late like the present season, may be described as an average one, and the appearance of a fair number of species rare in the British area is recorded in the Entomological Press. One of the features of 1906 was undoubtedly the appearance of a small Noctua, *Laphygma exigua*, usually a very scarce insect in these Islands, which occurred in remarkable profusion on the South Coast. Hundreds of specimens must have been taken, and it was found not only as an imago but also in the larval stage. *L. exigua* is a sub-tropical species and a terrible pest in districts where the indigo plant is cultivated. I have not heard of its capture in Hertfordshire, though there is a record of its having been taken in the neighbouring county of Essex. Another insect secured in some numbers in 1906, chiefly in the Southern Counties, is *Deilephila livornica*, the striped hawk-moth, the presence of which in Hertfordshire I have alluded to in previous reports.

I commenced sallow-beating in my garden on April 15th, when two common *Tæniocampæ*, *T. stabilis* and *T. gothica*, appeared, and later on the other usual sallow-haunting moths were present in average numbers. Another early insect which was rather abundant was *Amphidasys strataria (prodromaria)*, a number of the males being seen on the lamps near my house.

Miss Alice Dickinson, of New Farm, St. Albans, reports that butterflies were scarcer and also later than usual, but that *Vanessa urticæ* was very plentiful all the summer. The first

orange-tip (*Euchloë cardamines*) appeared on April 27th, but very few were seen afterwards. She visited Bricket Wood on May 29th and June 8th, but no fritillaries were out, vegetation in general being very backward.

While searching round hedges at night with a lantern she netted *Hepialus velleda*, *Axylia putris*, *Xylophasia hepatica*, *Mamestra sordida*, *Miana arcuosa*, *Rusina tenebrosa*, *Noctua festiva*, *Dianthecia cucubali* (on bladder-campion bloom), and *Aplecta advena*.

At sugar Miss Dickinson captured *Neuria reticulata*, *Hecatera serena*, *Hadena adusta*, and one *Agriopis aprilina* in October.

The following Geometræ were also netted round the fields in the evening:—*Acidalia dilutaria*, *A. aversata*, *Timandra amataria*, *Bapta temerata*, *B. bimaculata*, *Panagra petraria*, *Ligdia adustata*, *Emmelesia decolorata*, *Eupithecia succenturiata*, *E. vulgata*, *Melanippe montanata*, *Cidaria corylata*, *C. suffumata*, and *C. fulvata*.

Abraxas ulmata turned up again in its old locality, Batch Wood, Miss Dickinson's brother bringing her on June 10th the first specimen, which proved to be a pretty light variety. Five more good specimens were subsequently secured.

On July 6th Mr. Arthur Dickinson found a male and female *Zeuzera pyrina* on a telegraph post in the Sandridge Road.

Mr. P. J. Barraud, as usual, presents an interesting report. He says:—"The season on the whole, I think, quite came up to the average. Light and sugar were fairly attractive. Very little sallowing was done in the county, and no ivy-bloom was worked owing to the wet weather experienced at the time.

"The best captures at light at Bushey Heath are named below. One species, viz. *Gelechia diffinis*, is new to the Hertfordshire list, and those marked with an asterisk are new to my 'light' list. The total number of species captured in this way at this locality during the last eight or nine years now amounts to 307.

"*Drepana binaria*, *Dipterygia scabriuscula*, *Calymina pyralina*, *Hadena thalassina*, *Selenia lunaria*, *Tephrosia crepuscularia*,* *Eupithecia pulchellata*, *E. exiguata*, *Scoparia dubitalis*,* *Hedya dealbana*,* *Depressaria assimilella** (taken in 1904 and since named), *Gelechia diffinis*,* and *Plutella maculipennis (cruciferarum)*.*

"Other captures at light were:—*Spilosoma lubricipeda* (dark variety), *Lophopteryx camelina*, *Leucania comma*, *Axylia putris* (dark form), *Mamestra persicariæ*, *Grammesia trilinea*, *Caradrina morpheus*, *C. alsines*, *Noctua augur*, *N. plecta*, *Tæniocampa gothica*, *T. instabilis*, *Euplexia lucipara*, *Xylocampa lithoriza*, *Uropteryx sambucaria*, *Phigalia pilosaria (pedaria)*, *Hemerophila abruptaria*, *Eupithecia centaureata*, *Anticlea nigrofasciaria*, *Cidaria russata*, *Pelurga comitata*, *Herminia tarsipennalis*, and *Penthina variegana*.

"A specimen of *Phigalia pilosaria* was captured so early as January 26th.

"My sugaring was all done at Bushey Heath, and the following species amongst others were taken:—*Leucania comma, Hydræcia micacea, Dipterygia scabriuscula, Apamea unanimis, Miana fasciuncula, Caradrina morpheus, C. cubicularis, Agrotis suffusa, A. saucia, Noctua augur, Xanthia cerago, X. ferruginea, Polia flavicincta, Meselia oxyacanthæ, Agriopis aprilina, Euplexia lucipara, Hadena protea, H. genistæ,* and *Plusia iota.*

"By dusking, etc., in our garden, I obtained *Spilosoma lubricipeda* (dark variety), *Hepialus humuli* (female), *Hecatera serena, Plusia chrysitis, P. moneta, Uropteryx sambucaria, Pericallia syringaria, Halia wavaria, Anticlea nigrofasciaria, Coremia unidentaria, Botys urticata, Tortrix podana, Penthina ochroleucana, P. variegana, Sericoris urticana*; while at different times in the house odd specimens of *Gonoptera libatrix* (male and female in February and male and female in September), *Plusia chrysitis, Anticlea nigrofasciaria,* and *Pyralis farinalis* were taken.

"*Pieris rapæ* was first seen on April 11th, and on the same day three *Vanessa urticæ* were seen in the garden. One specimen of *Thecla w-album* was taken at Bushey Heath on July 16th; and *Vanessa atalanta* was seen at sugar in the garden on October 14th. A few *Plusia moneta* were bred from larvæ and pupæ found in Mr. Gibbs' garden at St. Albans.

"Several visits were paid to Pré Wood, St. Albans, in the company of Mr. Gibbs and Mr. Groves, the first being on March 31st to sallows, when we took *Tæniocampa gothica, T. instabilis, T. stabilis, T. populeti* (one), *T. cruda, Pachnobia rubricosa* (two), *Cerastis vaccinii,* and *Scopelosoma satellitia.* I obtained eggs from *T. gothica* and *T. cruda,* and now have pupæ of both. On April 22nd we took *Tephrosia crepuscularia* on tree-trunks, and again on May 13th, when *Pieris rapæ, Syrichthus malvæ, Euchloë cardamines,* and *Phoxopteryx lundana* were also seen. From a female *E. cardamines* I obtained a few eggs, and the resulting larvæ were fed on hedge-mustard, but owing to cannibalism or some other cause only one reached the pupa state.

"Two visits were paid to Aldbury Down, near Tring, the first occasion being June 17th. I found *Cœnonympha pamphilus* and *Lycæna alsus (minima)* common, and *Nisoniades tages* fairly so. *Lycæna astrarche (agestis)* (two), *Hesperia sylvanus, Euclidia mi, Scoparia dubitalis, Crambus hortuellus, C. pascuellus, Cnephasia subjectana,* and *Elachista argentella* were also taken, and two *Agrotis exclamationis* were seen flying about in the sunshine. On this occasion I made some observations on the resting-habits of *Nisoniades tages* and *Cœnonympha pamphilus,* which it may be of interest to mention. *N. tages,* when settling on a flower-head, almost invariably shifts its position until the head is pointing away from the sun, and frequently deflects the wings downwards until the tips of the forewing are below the body. The costa, or front edge of the wing, is curved downwards

towards the tip, and this adds to the effect. *C. pamphilus* usually rests with the wings closed, and almost always sits sideways to and leans away from the sun, thus allowing the rays to strike the wings at right angles.

"Another visit was paid to the same locality on August 4th, when *Lycæna corydon* and *Hesperia comma* were out in their usual abundance. I was again successful in taking a few *Hesperia thaumas (linea)*, but so far as I can find it is extremely local, being confined to a few square yards only. *Hyponomeuta cagnagellus* was also taken on this occasion.

"During the season I bred a number of *Angerona prunaria*, having reared the species from a female taken at Bricket Wood on 27th June, 1905. The moths emerged between June 17th and July 4th, there being about equal numbers of the type form and var. *corylaria*."

I am glad to receive from Mr. J. E. Perrott, of 10, Essex Road, Watford, some notes on his entomological work during the past season, when he and his brother spent a good deal of time collecting in the neighbourhood of his home. A fair number of *Plusia moneta* were taken in the garden, and he also bred this moth from larvæ taken on *Delphinium* in the spring. Mr. Perrott confirms the statement made in previous reports that this insect is becoming rather plentiful. His brother also captured two specimens of *Apamea ophiogramma*, in the case of which striped ribbon-grass appears to have been the attraction. In 1905 two specimens were taken and in 1906 three others. At Hagden Lane two specimens of *Ligdia adustata* and one of *Melanthia albicillata* were captured; at Bricket Wood, *Epione apiciaria*, a good series mostly females, one male of *Angeronia prunaria*, and one of *Neuronia popularis* both in 1905 and 1906. The humming-bird hawk-moth (*Macroglossa stellatarum*) was found at Tring.

Mr. V. P. Kitchin, of The Priory, Watford, again took *Chilo mucronellus* (a fine dark variety), *C. forficellus*, which is only recorded previously from the Sandridge district, and two specimens of *Geometra papilionaria*. All these insects were taken at light at or close to The Priory.

Mr. A. T. Goodson, of 18, Park Road, Tring, does not this year contribute any species new to our list, though several are not previously recorded from the Tring district. *Eurymene dolabraria* was taken in Ashridge Park. *Plusia moneta* was not rare and is evidently fairly established in the neighbourhood. *Pyralis glaucinalis* was tolerably common on clematis bloom, where *Eupithecia coronata* was also found, both near Tring town. *Drepana falcataria* was taken at Ashridge both as larva and imago, but it cannot be described as a plentiful species. *Noctua glareosa* was scarce, but Mr. Goodson reports the larvæ of *Charæas spartiata* as common on broom. One of this recorder's most interesting notes refers to the capture of *Heliothis peltigera*, which flew in at the Museum window and

was secured by Dr. K. Jorden on May 31st. This is not, however, an addition to the county list, as a specimen was taken at Hitchin in 1884 by Mr. J. Hartley Durrant. As already recorded in past years' reports by Mr. Arthur Cottam, the small elephant hawk-moth, *Chœrocampa porcellus*, is to be found in this neighbourhood, and Mr. Goodson informs me that he has taken so many as twenty larvæ in one night feeding on yellow galium. The large elephant hawk-moth, *C. elpenor*, was not scarce last season at Wilston Reservoir. The lobster-moth (*Stauropus fagi*), another interesting species, was taken by Mr. W. H. Smith in the beech woods to the west of the town. *Luperina cespitis* occurred commonly on the downs at Aldbury, together with *Charæas graminis*, the antler-moth, some very finely-marked forms of the latter being obtained. *Neuronia popularis* simply swarmed, as also did *Zygæna filipendulæ*, which was to be seen in thousands, but without any varieties worth mentioning, though hundreds of specimens were examined. Mr. Goodson remarks that he never met this moth in such profusion anywhere, and with its shining cocoons it presented a sight not to be forgotten.

Mr. A. H. Foster writes from 13, Tilehouse Street, Hitchin: "I found 1906 a good season on the whole, though I can mention nothing new among my captures. Beating hedges on Pegsdon Hills produced *Eupithecia scabiosata* in enormous numbers, and again I was able to find *Anticlea sinuata*, as between June 17th and July 4th I took ten specimens in this manner. I found that a very prolific method of collecting on these hills was to beat the hedges for about an hour and a half before dusk, and then when the light failed to search the waste ground, which was covered with campions and other flowers, by means of an acetylene bicycle-lamp and a net. By this method I secured the following, some of them in numbers:—*Chœrocampa porcellus*, *Neuria saponaria* (numerous), *Hadena dentina*, *Hecatera serena*, *Grammesia trilinea*, *Leucania comma*, *Apamea gemina*, *Dianthecia nana*, *D. cucubali*, *D. carpophaga*, *D. capsincola*, *Xylophasia hepatica*, *Aplecta advena*, *Mamestra anceps*, *Hadena genistæ*, *Xylophasia sublustris*, *Habrostola triplasia*, *Plusia gamma*, *P. chrysitis*, *Dipterygia pinastri*, *Chariclea umbra*, *Cucullia umbratica*, and *Axylia putris*. By beating the hedges and dusking the following were taken:—*Bapta taminata*, *B. temerata*, *Melanippe rivata*, *Anticlea sinuata*, *A. rubidata*, *Lomaspilis marginata*, *Cabera pusaria*, *C. exanthemata*, *Acidalia remutata*, *A. candidata*, *Melanippe montanata*, *Iodis lactearia*, *Geometra vernaria*, *Hemithea strigata*, *Eupithecia castigata*, *E. scabiosata*, *E. rectangulata*, *E. exiguata*, *E. Haworthiata*, *E. coronata*, and many others.

"At light the following were taken:—*Sphinx ligustri*, *Smerinthus ocellatus*, *S. tiliæ*, *Cerura vinula*, *Bryophila perla*, *Zeuzera æsculi*, *Lasiocampa quercifolia*, *Odonestis potatoria*, *Arctia caja*, and others. *Ino geryon* occurred in its customary abundance all over

the Pegsdon Hills, as did *Bombyx rubi*, larvæ in the autumn, imagines in July. I found *Eupithecia coronata* quite common on certain palings near Hitchin in May and again in August. The only insect I have taken which is new to me is *Eupithecia Haworthiata*. I found sugar quite a failure, and Mr. Grellett had the same experience. He and his brothers sugared in their own garden pretty regularly, but in 1906 nothing of any note was taken with the exception of *Cymatophora ocularis*, of which two specimens occurred."

It is with deep regret that I have to record the death of an esteemed correspondent and experienced Lepidopterist in the person of Mr. William Christopher Boyd, J.P., of The Grange, Waltham Cross. Mr. Boyd belonged to the old school of Entomologists, now, I am sorry to say, a rapidly decreasing band, whose work is to be found recorded in the earlier numbers of the scientific magazines. He and his confrères of the past generation had the honour of adding new species of Lepidoptera to our British fauna, an achievement which, in these later days, when the field is being so thoroughly worked, very few of us can hope to emulate. To wide experience and trained observation Mr. Boyd added a genial disposition, and was ever-ready to help the enquirer and to impart to others the rich stores of knowledge he possessed. He was not a fireside naturalist; his experience was gained in the field, and in his study of nature he had accumulated a vast fund of information with regard to the habits and haunts of the creatures in whose life-histories he took so great a delight. Possessing a rich fund of quiet humour, he was a delightful companion, and those who had the advantage of his personal acquaintance will ever look back with pleasure to the hours spent in his society. His observations on Hertfordshire Lepidoptera, extending over a period of half a century, resulted in the publication in our 'Transactions' of a list of the species taken by him in the neighbourhood of Cheshunt, which I venture to think is one of the most valuable and complete lists published by our own or any other provincial Society. I am also indebted to Mr. Boyd for help rendered to me from year to year in the compilation of my annual report. His death, which took place in September, 1906, leaves us without an entomological observer in the eastern division of the county.

XVIII.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE IN THE YEAR 1906.

By William Bickerton, F.Z.S., M.B.O.U.

Read at Watford, 23rd April, 1907.

At the end of 1905 the list of birds recorded for Hertfordshire included 224 species, and to this list only one new-comer has to be added for 1906. This is the Black Grouse (*Tetrao tetrix*), the female of which is known as the grey-hen, and it is a female specimen or grey-hen that has been taken near Watford.

The occurrence was reported in 'The Field' of 8th December, 1906, by Mr. W. Hurst Flint, who stated that: "While pheasant-shooting in the Gullet Wood, about a mile distant from Watford, on December 1st, one of the guns killed a fine specimen of the grey-hen. Such an occurrence prompts me to ask whether anyone can explain the presence of so unusual a visitor." Perhaps as some sort of response to Mr. Hurst Flint's enquiry, the following paragraph appeared in 'Country Life,' on 5th January, 1907:—"The land-rail is so scarce a bird at all times in East Anglia that the recent killing of one of the species in that part of England in November is really a very curious occurrence. It is not, indeed, the most extraordinary appearance of an unexpected bird which has been recorded lately. The palm in that respect has certainly to be awarded to the grey-hen lately killed at Watford.

"Many suggestions of more or less futility have been made to account for the presence of the bird in this curious locality; the most plausible, perhaps, is that which is also the most prosaic, that it came down by the London and North-Western Railway from the North. Possibly it may have stunned itself in flight against telegraph-wires, have fallen into a truck of a passing train, and only come to its senses and to its power of flight again when it arrived at Watford. If that is a correct solution—but this is a puzzle for which imagination may suggest many answers—it might just as well have made its appearance in Euston Station, where it would have been still more of a surprise."

I hardly like to attempt an explanation of the occurrence. It is rarely safe to speculate on the causes of such chance happenings in the bird-world, and speculation is all that the circumstances of the case allow. Doubtless the bird was changing its quarters from one part of the country to another, and by some strange chance or mischance it came to earth in Gullet Wood, and that is all one can safely say. Consider these facts for a moment. There are in the British list of birds three distinct species bearing the name grouse. These are Pallas's sand-grouse (*Syrrhaptes paradoxus*), the black grouse (*Tetrao*

tetrix), and the red grouse (*Lagopus scoticus*). The first-named of these is a bird of the most erratic and irruptive character, whose home, according to Mr. Howard Saunders, "is to be found from the eastern side of the Caspian Sea to the Tian-Shan and the Altai ranges, all over Mongolia and Southern Dauria, down to the Koko-nor and Tsaidam, and in winter to the plains of Pechili, in China." The second of the three, the black grouse or black-game, is a resident bird in parts of England, in Scotland, Scandinavia, Russia, and the hilly districts of Germany and Central Europe. The third, the red grouse, is found as a native bird in the British Isles alone, and occurs in no other part of the world, save in places where attempts may have been made to introduce it. Now, Pallas's sand-grouse, the Central Asian "grouse," has been recorded in Hertfordshire on six different occasions since 1863, 23 individual birds having been obtained or seen. Yet the grey-hen shot at Watford is the first recorded specimen of the black grouse for Hertfordshire, and the red grouse, one of a very small number of species which are absolutely confined to the British Isles alone, has never yet been seen in or recorded from the county. What a crazy patchwork of ornithological eccentricity facts like these make when placed side by side! And if anyone wishes to indulge in the pleasant pastime of speculation, such facts as these will give plenty of material to work upon.

The male black grouse is known as the black-cock, the female as the grey-hen, and these names indicate in a general way the differences in plumage. Black grouse are found (according to Mr. Howard Saunders) "locally and in small numbers in Devon, Cornwall, and Somerset, while they still maintain themselves in Dorset, Wilts, and the New Forest district. In Sussex, Surrey, and Berkshire their presence is the result of re-introduction early in the present century, and none are now to be found in Kent. They are scattered locally over the wilder portions of the Midland counties, the Marches, and many parts of Wales, and north of Sherwood Forest in every English county. They are distributed in varying numbers over the mainland of Scotland, and in many of the Inner Hebrides, but in Ireland were never indigenous." A distribution which I venture to remark makes it still more curious to reflect that the bird has never before been recorded for Hertfordshire.

In his 'Recreations of a Naturalist,' Mr. J. E. Harting writes as follows upon the black grouse:—"There was a time when black-game was spread all over the country from north to south, wherever the conditions were favourable to its mode of living, and its existence at the present time in the West of England, side by side with the red deer, is only a survival, owing to the unchanged nature of its ancient haunts. Needless to say, it is a moorland bird, often living where red grouse are, but oftener where there are none or very few, for the nature of its haunts is somewhat different. The red grouse lie out on the open moor, where they

find no cover but heather in profusion; the black-game affect the rough, hilly ground bordering cultivated land where there are plantations of fir and birch, in which they perch like pheasants, hiding in the thick bracken on the sides of the hills, drawing down to the rushy bottoms and moist ground about the burns, where they find most of their daily fare, and visiting the oatfields at twilight. They may even be found sometimes in fields of roots or potatoes, at some distance from their usual haunts, for they are strong fliers, and when crossing a valley or travelling at a height, look something like wild ducks, flying in a straight line with outstretched heads and necks. In their fondness for acorns and oats they also remind one of the ducks, and, like them, come off the moor at sundown in search of this kind of food. In the early morning they may be seen flying out from the birch-woods and making for the patches of bracken on the hillsides, their black and white plumage showing up finely against such a background in the gleam of the rising sun."

General Notes.

My general notes commence, as usual, with the Thrush family, and first of all with the song-thrush (*Turdus musicus*). Two points worthy of comment with regard to this commonest of birds come out from the year's records: (1) The tendency (noted last year) to re-commence singing in autumn has again been observed. In bygone years one never seemed to hear, or expected to hear, of thrushes singing before January or February of the year, but latterly reports have come to hand of these birds singing in December, in November, and even in October. Thus, Mr. F. W. Headley, M.A., of Haileybury, notes that on October 5th a thrush or two were singing, and again on October 15th that a thrush was singing. Mr. M. Vaughan, M.A., also of Haileybury, notes that thrushes sang vigorously during the latter part of November. (2) A tendency to change of habit in the choice of nesting-sites. Thus Mr. Headley also reports: "Near the Lea, a little above Hertford, quite a number of thrushes' nests were built on the ground. Is this because vermin are getting killed down? Mr. J. H. Buxton has noticed the same thing near his house at Hunsdonbury." It may add to the interest of this point to note that I saw five instances myself of thrushes' nests built right on the ground. One of these was in an osier-bed and only a few yards away from the riverside (Colne) near Watford, two others were in thick reed-beds, where wild ducks were freely nesting, while a fourth nest was built right in the centre of the fronds of a fern just where these sprang up from the ground. This was within a thick wood. In the fifth instance the nest was placed in a bunch of nettles about eighteen inches down the steep side of a narrow ditch, and was that distance below the general level of the ground through which the ditch ran. This was at Cassio Bridge. Mr. A. W. Dickinson (St. Albans) also reports a blackbird's nest in

a bramble quite on the ground in Batch Wood. I may add also that one of my gamekeeper friends tells me that it is quite a common occurrence to find thrushes' nests (and also blackbirds') on the ground. Since writing the above, Dr. Hartert (Tring) reports that: "In the reeds on the reservoirs several thrushes' nests were found a few inches above the ground."

Mr. Hopkinson sends a note (taken from the 'Hertfordshire Mercury') to the effect that in a secluded part of a garden at Braughing there was a thrush's nest in which four young ones were hatched out as early as March 17th.

With regard to the fieldfares (*Turdus pilaris*) and redwings (*T. iliacus*), it is pleasant to hear from Mr. Headley that, in the early months of 1906, the latter, contrary to the almost general experience of recent years, were more numerous than the former. This was not the case in the Watford district, where fieldfares always greatly outnumber their smaller companions. I saw, and heard, a small party of fieldfares near Munden so late as April 29th—the latest date I have ever met with this species. Coming to the close of the year, there was about the usual number of these two immigrant species until just before and during the time of the great snowstorm of December 25th and 26th. Then they appeared in the Colne Valley in extraordinary numbers, and on the morning of December 26th I saw large flocks of them coming down the valley from N.E., and heading off S.W., being apparently driven onwards by that memorable storm. Reports from many parts of the country showed that this great south-westerly movement of redwings, fieldfares, and other small birds at the time of the great storm, was one of the most extraordinary bird movements which has been witnessed within recent times in the British Isles. Mr. A. H. Foster, of Hitchin, reports an albino fieldfare, shot at High Down, near Hitchin.

Wheatear (*Saxicola œnanthe*).—I only saw one specimen of this bird, and that was near Croxley Mills, on April 8th. Mr. G. M. Mathews, F.L.S., reports a party of eight, also seen early in April, near Watford, and Mr. A. Grey reports one at St. Albans on March 27th.

Stonechat (*Pratincola rubicola*).—Last year I reported that I had found the nest of the stonechat near Watford in 1905. I have found what appears to be the same pair of birds nesting again in 1906, and, strange to say, the 1906 nest was within two feet of the nesting-site of 1905, although between the nesting-time of 1905 and that of 1906 I never saw any stonechats in that locality. I first found my 1906 nest on March 15th, when it appeared to be about half-built. On March 19th the nest was lined with hair, and apparently completed, though it contained no eggs. On the 23rd there were two eggs in it, and the following note taken from my rough notebook on this date adds a point of interest:—"I might note that it has snowed several times to-day, and that a light snow was falling as I stood by the stonechat's nest and fetched out the eggs." On March 26th the

nest contained four eggs, and the bird had commenced sitting. On April 8th the eggs were still unhatched, but on April 11th the young birds were out and seemed to be about two days old. As incubation commenced on March 25th, and was completed probably on April 9th, the period of incubation for the stonechat seems to be about fifteen or sixteen days. Unfortunately I was not able to again visit the nest until April 29th. The young birds had then left the nest, and were able to fly well, for I saw three of them about. No second brood was reared in that particular spot, and I have never seen the birds there since.

Chiffchaff (*Phylloscopus rufus*).—I saw a single chiffchaff at Cassio Bridge on March 18th, 1906, the earliest date on which I have ever seen one. Though it was a bleak, cold day, the little *voyageur* seemed quite happy and contented, and full of life, activity, and vivacity, as it flitted merrily along the side of the stream near the footbridge. An interesting note *re* this little bird comes from Haileybury, Mr. Vaughan writing as follows:—"I heard the chiffchaff on September 28th, 29th, and October 1st. Its stay was probably due to the warm weather." It is well-known that the chiffchaff, like some other birds, recommences to sing after the annual moult, but this is the first record of the occurrence which I remember to have had in Hertfordshire.

Wood-Wren (*Phylloscopus sibilatrix*).—This small warbler did not appear at all in the records for 1905. For 1906, however, it is reported by Mr. P. J. Barraud (Bushey Heath) on May 2nd, and by Mr. Headley (Haileybury) as singing on May 24th, and as still in song on June 25th. I have never seen or heard this bird in my district.

Grasshopper-Warbler (*Locustella nævia*).—I have received only two notes on this rare species. Mr. Vaughan (Haileybury) says: "I used to hear the grasshopper-warbler in the vicinity of the College, but have not done so for years." Mr. A. W. Dickinson (St. Albans) includes it in the list of birds which are becoming scarcer in the county.

Tits.—Mr. Hopkinson has sent to me the subjoined note *re* the "tomtit," taken from the 'Hertfordshire Mercury,' 16th June, 1906, under the local news from Codicote:—"*A Strange Nesting-place.*—As a tradesman of the village was in his garden a few days ago he noticed a tomtit come from the direction of his beehives. On making an inspection he found that a tomtit's nest had been built in one of his bar-framed hives, and the nest contained eleven eggs. It was evident that the birds had got access to the hive from the back. The nest was well built, and is certainly a novelty, it being fourteen inches long, three and a half inches wide, and two and a half inches in depth throughout. These birds have been known to be very destructive to bees in the early spring. The nest containing the eggs was handed over to our correspondent, and has been inspected by a large number of people." I imagine that all the four commoner species

of tits are "tomtits" to the uninitiated, so that the exact species is not recorded. Probably it was the blue tit (*Parus cæruleus*).

Tree-Creeper (*Certhia familiaris*).—In my notes of last year I stated as follows:—"In 1902 I reported on the then increasing scarcity of this attractive little bird. I regret that I cannot now, after three years' further observation, report any increase in its numbers so far as the Watford district is concerned. In fact, it seems to get more and more scarce each year. I have only seen three during the year." I think these remarks must, in some mysterious way, have gone the round of all the tree-creepers in the Watford district, and that one and all must have conspired to resent and to refute the statement thus made against their tribe. For certain it is that I have seen tree-creepers all through the year, in all parts of the district, and in such numbers that I had never looked upon as possible for so comparatively rare a species as I had regarded this to be. I do not mean that I have seen large numbers together, or at once, for tree-creepers are anything but sociable birds, and one never sees more than one or two at a time. But I have seen them almost on every ramble I have taken, and sometimes I have seen as many as half a dozen on one morning's walk. And, as I happened to mention in the discussion which followed my last year's paper at St. Albans, I have actually had the pleasure of hearing one sing.

This interesting little incident happened on 4th March, 1906, in Cassiobury Park. I watched a pair of tree-creepers fly on to one of the elms in the large cross-avenue, and time after time in their upward progression round the trunk I saw and heard one of them give out a bright, sweet little song that I had never heard before in my life, and may probably never hear again. As a matter of fact, I did not at the time realise the full significance of this little incident. To mention that one has for the first time in one's life heard a particular bird give forth its song may perhaps strike some of you as an attempt to "magnify the trivial," but in this instance, at any rate, it is not so. For when I tell you that Macgillivray, the great Scots naturalist, whose five-volume work on birds is one of the classics of ornithological literature, never heard the tree-creeper sing; that Mr. W. Warde Fowler, of Oxford, one of the most distinguished of the field-naturalists of to-day, and one of the most delightful writers on birds and their ways, has only once during a long life of observation heard the song of the tree-creeper; when I tell you that Dr. R. Bowdler Sharpe, head of the Bird Department at the Natural History Museum at South Kensington, writes as follows in his 'Handbook to the Birds of Great Britain':—"The creeper has been credited with a song, and some observations have recorded the fact in this country. Although we have been acquainted with the species from boyhood, we have never heard a tree-creeper sing in England, though the Continental birds undoubtedly do sing, and we remember once hearing a bird in France"; when I add that Miss Armitt, of Rydal, who knows

so well, and who has written so charmingly on, the bird-life of the Lake District, states: "Song, so far as my knowledge goes, the tree-creeper has none, or if he has, he successfully hides it in these parts"; then I think you will agree with me that I am quite justified in recording the fact that here in Hertfordshire, in the year 1906, I have had the pleasure of hearing the tree-creeper sing, although, as I have stated, I did not realise at the time the significance or the rarity of the occurrence that came accidentally across my path. Needless to say, I shall always treasure the memory of what I now regard as one of the "red-letter" incidents of my bird-watching experiences.

Red-backed Shrike (*Lanius collurio*).—I think it is worth recording that I last year found the nest (containing five eggs) of this species within 300 yards of the outskirts of Watford. It is the first nest of its kind I have found in this district.

Swallow (*Hirundo rustica*) and House-Martin (*Chelidon urbica*).—Contrary to custom I have received very few notes this year on these common species. Mr. Headley reports that young house-martins were still in the nest at St. Margarets so late as October 9th; that about a dozen young swallows were seen about on October 16th, and about the same number of house-martins on October 18th—a date, curiously enough, on which Mr. Headley heard the first fieldfares of the autumn. The same observer sends the following note:—"On a cottage three miles the other side of Hertford, there were 31 house-martins' nests. Not many years back there were 70. Why do they choose this cottage—a small inn? The landlord once told me it was because all his neighbours swept the nests down." This is an excellent illustration of how much good one real sympathiser with the birds can do in his own quiet but effective way.

Hawfinch (*Coccothraustes vulgaris*).—Mr. M. Vaughan (Haileybury) reports that on February 21st he saw fourteen hawfinches together. This is the largest number I have heard of here in one flock.

House-Sparrow (*Passer domesticus*).—It is not often, I think, that bird observers interest themselves in the plebeian house-sparrow. Mr. Matthew Arnold has, however, sent to me (per Mr. E. Mawley) the following interesting note:—"The last week in December, 1905, at Home Park Mills, King's Langley, I saw a white sparrow. The bird was of a snowy-white colour, with a few brown feathers on each wing, and a few brownish feathers near the tail. I saw this bird several times during the first week or so in January, 1906, and then lost sight of it. I did not see it again until May, 1906, when I saw it at the same spot. But this time the feathers were cream-colour instead of white, and there were more brown feathers on the back. I last saw the bird the first week in June, by which time it showed a mottled appearance, about half cream and half brown. This

note I thought might be interesting as an example of a white bird changing colour apparently after moulting."

Brambling (*Fringilla montifringilla*).—These winter visitors were very plentiful during the early months of 1906, but I did not once see a specimen in the later months of the year, not even during the hard weather in the latter part of December. Mr. A. H. Foster (Hitchin) reports: "Bramblings abundant locally as usual." Dr. Hartert (Tring) states that he hardly saw any bramblings and that usually they are numerous in the Tring district.

Magpie (*Pica rustica*).—This bird is still as scarce as in former years. I saw a pair near Elstree in mid-July, and the only other notice sent to me is from Mr. Vaughan, who states that he has only seen two magpies in thirty years.

Wryneck (*Iÿnx torquilla*).—Several reports of the appearance of this bird in the spring are to hand. Mr. Headley states that in his district it began singing again (i.e., after the moult) on July 18th.

White or Barn-Owl (*Strix flammea*).—Mr. R. Vale, of Chalk Hill, reports that as his son and another youth were going home from Watford about 9.30 p.m. on March 12th they saw a large white bird hovering round the ivy-mantled house next to Benskin's offices. This was doubtless a barn-owl, and very probably it was systematically "beating" the ivy with its wings in order to startle the sparrows, and capture them as they were flushed out. Possibly mice were scarce at that time, or the owl may have been trying a change of diet. I have also a note to the effect that both the little owl (*Athene noctua*) and the scops-owl (*Scops giu*) continue to live in a certain district in this county, which I am specially desired (for obvious reasons) not to indicate. This is, to my mind, one of the most interesting records of the year, and I am sure all bird-lovers will wish "continued prosperity" to these two small but exceedingly interesting strangers of the owl family.

Heron (*Ardea cinerea*).—Several of my correspondents have noted that the heron has been more numerous during 1906, and this, in spite of the facts that he is well kept down in the interests of anglers, and that there is, so far as I know, no heronry in the county. I think it is worth mentioning that one evening in July, as Mr. D. Hill and myself were standing just outside the Public Library in Queen Street, Watford, we saw a heron fly right above us. He was at a good height, and was heading westwards.

Mr. P. J. Barraud (Bushey) calls attention to a very interesting question in connection with the herons, that, viz., as to whether they have the power of emitting a phosphorescent light when fishing in the darkness, and so of alluring prey to the spot where they stand. The subject is discussed in an article entitled "The Fascination of Light," which appears in 'Recreations

of a Naturalist,' by Mr. J. E. Harting, a book published in 1906. Briefly summed up, the line of argument is as follows:—(1) Many animals are attracted, if not fascinated, by a light exhibited in the darkness, e.g., moths by a candle, birds by a lighthouse, deer enticed within rifle shot by showing a light. (2) This being so, have any wild creatures the power of emitting a phosphorescent light for the purpose of attracting and alluring their prey? (3) The late Edward Jesse, in his 'Gleanings of Natural History,' wrote: "It has been supposed that a light is emitted by herons from their breasts as they stand in the water of an evening waiting for fish. I should like to be assured of the accuracy of this supposition." (4) Are certain portions of the plumage (of herons) luminous so that they can illumine the water over a small area just in front of them, and thus lure the fish to them? (5) Mr. Harting thinks that this is so, and he believes that the alleged luminosity of the breast-feathers is to be correlated with the so-called "powder-down" patches observed both in the European and American herons and bitterns. Instances of this luminosity are then given (in the book referred to), especially in connection with the great blue heron of America (*Ardea herodias*). The whole subject is a very difficult one, and I have yet to meet with the heron that either by night or by day will allow any observer to get sufficiently near to make close observations of this kind. I commend the subject, however, to those naturalists who may be more fortunate.

Bittern (*Botaurus stellaris*).—Judging by the frequency of the records of this bird in the natural history papers, one might almost call 1906 "a bittern year," and Hertfordshire has not been left unvisited. Lady Ebury informs me that one has been seen at Rickmansworth, Mr. W. Graveson (Hertford) states that "there have been two bitterns in this neighbourhood during the winter," and Mr. Hopkinson has sent to me the following note from the 'Hertfordshire Mercury' of 27th January, 1906:—"*Fight with a Bittern.*—While out shooting along the river-side near Bulwell, Mr. Widdowson shot and wounded a fine specimen of the English bittern, now rarely seen in this country. When his keeper went to pick it up the bird attacked him furiously for some time, and subsequently turning on to the keeper's dog bit the animal severely. Eventually the keeper killed the bird." I have also heard of a bird supposed to have been a bittern, having been seen by some of the members of the Bushey Golf Club on their links, but as other members of the club who also saw it declared it to be a goose, I cannot venture an opinion as to what this strange visitor really was.

Wild Duck or Mallard (*Anas boscas*).—An occurrence which I think constitutes an "early-nesting" record, even for this early-nesting species, was brought to my notice in January (1906). This was the nest containing ten eggs of a wild duck, and I saw and photographed the bird on the nest on January 28th. Two days later—so the keeper told me—all the eggs were hatched

out, and indeed in a photograph which I took of the eggs, two of them are seen to be "chipping." Now, taking twenty-six days as the period of incubation of this species, it will be evident that the whole of the eggs were laid by about January 4th, and assuming that they were laid at the rate of one each day, it follows that some five or six of them were laid *during the last week of December*, 1905! The locality was in the Colne Valley between Watford and Rickmansworth.

Long-tailed Duck (*Harelda glacialis*).—This bird has only once been recorded for the county, a specimen having been taken at Tring in October, 1892. The Hon. Walter Rothschild, M.P., informs me that: "On 12th November, 1906, a fine male long-tailed duck was shot on the reservoirs. The head and underside were fully moulted into the winter plumage, while the back was in full moult from the summer to the winter plumage." This particular duck, as a rule, only nests in any numbers to the north of the Arctic Circle, and especially in Iceland.

Moorhen (*Gallinula chloropus*).—I had a note in my last report as to the tendency of moorhens to become tamer and less shy of approach. The following note sent by Mr. A. W. Dickinson (St. Albans) gives further evidence of the same tendency:—"A male moorhen came to the garden here in the middle of March, and washed every day in a small cavity in large 'pudding' stone on rockery in front of house, and only a few yards from windows. The cavity is only large enough for the moorhen to sit in, and is kept filled with water for the use of smaller birds, and is frequently used as a bath by many different species."

Ringed Plover (*Ægialitis hiaticola*).—On October 7th I saw six birds of this species, associated with three dunlins (*Tringa alpina*) at the Marsworth Reservoir. These are the first I have personally seen in the county, although they visit these reservoirs regularly each year.

Golden Plover (*Charadrius pluvialis*).—Mr. Dickinson (St. Albans) reports this bird as scarcer during 1906 than in previous years. On the other hand, Mr. Vaughan (Haileybury) writes as follows:—"A good year for golden plover. I saw large flocks on January 24th, February 22nd, 28th, and March 1st. On March 1st the biggest flock I have seen for years, consisting of quite 300 birds. In a few cases the black breast was beginning to show." Mr. Vaughan also reports that he first saw it on its return in autumn on October 30th. Now these are very interesting notes, and when one looks back over the records for several years past, one is forced to the conclusion that the golden plover is a regular—and in some years a very numerous—visitor to the eastern part of the county; that it gradually "thins off" towards the central parts (Mr. Dickinson, New Farm, St. Albans, reports it almost every year); and over here in the western district it is extremely scarce. I have never seen

the bird at all during my eight years' residence in the district, but I have occasionally heard of small parties having been seen in the Colne Valley between Munden and Rickmansworth, by observers more favourably placed than myself. It is worth noting, too, that a similar conclusion holds good with regard to the grey crow (*Corvus cornix*). Its presence is every year reported by Mr. Headley and Mr. Vaughan, in the east of the county; last year one was reported from the St. Albans district as a great rarity; in the Watford district I have never seen it, and I do not remember that a single instance of its appearance here has ever been reported to me. As I have said, these differences in the distribution of our birds over various parts of the county are extremely interesting, and I wish that other observers would make and supply me with notes, on similar lines, with regard to other species.

Common Snipe (*Gallinago cœlestis*).—It may be remembered that last year I reported the nesting (for the first time recorded in our 'Transactions') of this species near Watford. Though there were plenty of snipe about in the early months of 1906, I did not hear of a nest being found. The birds were about here until nearly the end of April. During the cold weather at the close of the year numbers of snipe came down the river-valley, and during a walk on December 23rd I flushed no less than 13 within a mile and a half of the town.

The Sandpipers.—Thanks to the fact that I have been allowed during 1906 to extend my observations over portions of the district to which hitherto I have not had access, I have been able to add two species of sandpiper to my list of birds seen in the immediate neighbourhood of Watford.

On the evening of May 7th I flushed a pair of common sandpipers (*Totanus hypoleucus*), and though I have been familiar with this bird in other counties for several years, I have never before seen it in Herts.

On November 18th I flushed from one of the ditches in the water-meadows near Otterspool three birds that were totally strange to me, and which from their general appearance, behaviour, and manner of flight I thought very probably belonged to the Sandpiper family. One very marked characteristic of the plumage I could not help noticing, and this was a fine broadly-marked band of pure white across the lower part of the back and also across the expanded tail. It was very conspicuous indeed in flight, and, as it happened, it was by means of this perfectly characteristic feature that I was subsequently able to decide what the birds were. Upon mentioning the matter to Mr. G. M. Mathews, of Watford, he very kindly allowed me to look through his truly magnificent set of Gould's ornithological works, and on turning up the Sandpiper family we had no difficulty in identifying my new "find" as the green sandpiper (*Totanus ochropus*), and, curiously enough, in spite of the fact that I had never before seen the bird anywhere, nor heard of it

from anyone here, I have come to the conclusion that it is a regular and by no means infrequent visitor to the river-valley in our district, both on the autumn and spring migrations, if indeed its apparently leisurely movements up and down our valley are to be called migrations. I first saw three specimens as stated on November 18th, and since that date I have seen other specimens on November 25th, December 23rd and 26th, and on the 6th of January, 1907. Apparently it then disappeared from the district, but I was pleased to see it again on the return migration on 24th March, 1907, near Rickmansworth, and again in the selfsame spot on the 7th of April. Evidently, therefore, it is a fairly common winter visitor with us, and I hope that other observers who may be more fortunately placed than myself may take note of its occurrence. To me the bird has been not only one of the most interesting visitors, but also one of the great surprises of the year. I may add that in Mr. Crossman's list of Hertfordshire birds (1899) he refers to the green sandpiper as follows:—"A regular visitor on migration to the Tring Reservoirs, and also to Ickleford, near Hitchin." It is worth noting also that the nesting-habits of the green sandpiper show a remarkable difference from those of all other members of the family, its nest being built, to quote Mr. Howard Saunders again, in "old squirrels' dreys, or in the nests of song-thrushes, missel-thrushes, blackbirds, jays, and ringdoves, on moss-covered stumps, broken-down trees, and spines heaped upon branches of firs, at elevations reaching to 35 feet, but always in proximity to pools." It has, however, never been known to nest in the British Isles, although many experienced ornithologists believe that it does nest with us occasionally.

A third member of the family, the purple sandpiper (*Totanus striatus*), is reported from Hertford by Mr. W. Graveson, but no details are given. Should this record be confirmed it will form a new species to be added to our county list.

Redshank (*Totanus calidris*).—Last year I reported the all but absolute certainty that at least one pair, and probably two pairs, of these birds had nested in 1905 near Watford. I kept a sharp look out for them in the spring of 1906, and on April 23rd I was delighted to see a pair of them back on the same ground. I was in hopes of seeing nest and eggs in due course, but to my great disappointment I did not see the birds again all the spring and summer, though I looked carefully for them all through.

Gulls.—Last year seems to have been an unusual one for gulls visiting Hertfordshire. Mr. J. R. Ismay informs me that he saw one of the smaller species of gulls (probably *Larus ridibundus*) at Hunton Bridge in August; Mr. A. W. Dickinson (New Farm, St. Albans) reports three gulls (probably herring-gulls) following the plough in the autumn, about November; on December 2nd I saw three (species uncertain) near Croxley Mills; and on December 30th I saw a herring-gull at Tolpits.

The greatest and most extraordinary visitation, however, took place during the last few days of the year at Watford. When the snow of Christmas week melted, it caused considerable bodies of flood-water to inundate the low-lying water-meadows of the Colne Valley, and these floods seemed in some way or other to have proved a powerful attraction to the gulls, especially in the area just above the London and North-Western Railway. I was unable to make any careful observation of them until the 6th of January, 1907, and I then counted 53 birds, and this after one contingent had disappeared from sight. I should think, therefore, that there were at least 70 or 80 birds in all. There were two species at least—the larger herring-gull (*Larus argentatus*) and the smaller black-headed gull (*L. ridibundus*). The former made up two-thirds of the flock and the latter one-third, roughly speaking. There is no record in our 'Transactions' of any such large visitation of gulls to Hertfordshire, though 36 herring-gulls are reported to have been seen near Hertford in 1897.

Great Crested Grebe (*Podicipes cristatus*).—I am informed that for the first time for many years this handsome bird has nested at the Elstree Reservoir, but that, sad to relate, the nest was despoiled of its eggs by some person lodging in the village. It is a pity this ruthless "collector"—he cannot surely be a naturalist—was not prosecuted for his vandalism. It is just the way with the callous collector—if there is only one clutch of eggs of any particular bird in a county he *will* "bag" them, even at the risk of exterminating the species.

Little Grebe (*Podicipes fluviatilis*).—Though this active little diver is very common in the main stream of the Colne, I have never until last autumn seen a specimen on the Gade. It is therefore worth recording that on December 9th I saw three birds of the species on that stretch of the river which winds through Cassiobury Park.

The eggs of the cuckoo have been recorded as found in the nests of the following birds:—Hedge-sparrow, robin, pied wagtail, tree-pipit, redstart, and reed-warbler.

The following birds are reported as having been more plentiful during 1906:—Heron, greenfinch, fieldfare, golden plover, partridge, blackbird, thrushes, chaffinch, linnet, redwing, lesser whitethroat, hawfinch, goldfinch, starling, bullfinch, snipe; while the subjoined are said to be scarcer:—Corncrake, owls, hawks, kingfisher, coot, redwing, fieldfare, brambling, yellow-hammer, woodcock, snipe, blackcap, green plover, golden plover.

The following, in addition to the case of the tomtit quoted above, have been reported as curious nesting-places:—(1) Greenfinch's nest under the eaves of a straw-rick about seven feet from the ground. The young ones were reared successfully. (2) Hedge-sparrow's nest in a roll of wire standing near hedge. The nest was about ten or twelve inches from top. One or two

eggs were laid, and the nest then deserted. (3) The nest of a song-thrush built in a house in course of construction in Sandpit Lane, St. Albans.

In concluding my report, I desire to again thank all the ladies and gentlemen who have so kindly supplied me with their notes and observations. Their work has again been most valuable and interesting, and without it our Society could not possibly collect nearly so much information year by year about the bird-life of our county.

Summer Migrants.

Species.	Locality.	Date.	Observer.
Wheatear (*Saxicola œnanthe*)	St. Albans	Mar. 27	A. Grey.
	Croxley Mills	April 8	W. Bickerton.
	Hitchin	,, 12	A. H. Foster.
Whinchat (*Pratincola rubetra*)	Croxley Moor	May 13	W. Bickerton.
Redstart (*Ruticilla phœnicurus*)	Elstree	April 12	E. P. Thompson.
Nightingale (*Daulias luscinia*)	Hitchin	,, 14	A. H. Foster.
	Hatfield	,, 14	Miss R. Blackett.
	Berkhamsted	,, 15	Mrs. E. Mawley.
	St. Albans	,, 17	H. Lewis.
	,, (New Farm)	,, 21	A. W. Dickinson.
	Bushey Heath	,, 22	P. J. Barraud.
	Sawbridgeworth	,, 23	H. S. Rivers.
	Watford	,, 24	W. Bickerton.
Greater Whitethroat (*Sylvia cinerea*)	,,	,, 29	,,
	Bushey Heath	May 2	P. J. Barraud.
Lesser Whitethroat (*Sylvia curruca*)	,,	,, 9	,,
	Haileybury	,, 12	F. W. Headley.
Blackcap (*Sylvia atricapilla*)	Hitchin	April 5	A. H. Foster.
	Cassio Bridge	,, 29	W. Bickerton.
	St. Albans	May 3	H. Lewis.
Garden-Warbler (*Sylvia hortensis*)	Bushey Heath	April 26	P. J. Barraud.
	St. Albans (N.Fm.)	,, 27	A. W. Dickinson.
Chiffchaff (*Phylloscopus rufus*)	Cassio Bridge	Mar. 18	W. Bickerton.
	Haileybury	,, 31	M. Vaughan.
	Hitchin	April 1	A. H. Foster.
	Bushey Heath	,, 5	P. J. Barraud.
	Elstree	,, 8	E. P. Thompson.
	St. Albans	,, 13	H. Lewis.
Willow-Wren (*Phylloscopus trochilus*)	Hitchin	,, 5	A. H. Foster.
	St. Albans	,, 11	H. Lewis.
	,, (New Farm)	,, 12	A. W. Dickinson.
	Bushey Heath	,, 12	P. J. Barraud.
	Elstree	,, 13	E. P. Thompson.
Wood-Wren (*Phylloscopus sibilatrix*)	Bushey Heath	May 2	P. J. Barraud.
Sedge-Warbler (*Acrocephalus phragmitis*)	Tring	April 30	W. Bickerton.
Yellow Wagtail (*Motacilla raii*)	Croxley Moor	,, 29	,,
Tree-Pipit (*Anthus trivialis*)	Watford	,, 29	,,
	Haileybury	May 5	F. W. Headley.
Red-backed Shrike (*Lanius collurio*)	Hitchin	,, 13	A. H. Foster.
	Tring	,, 17	W. Bickerton.

Species.	Locality.	Date.	Observer.
Spotted Flycatcher	Hatfield	May 3	Miss R. Blackett.
(*Muscicapa grisola*)	Sawbridgeworth	,, 9	H. S. Rivers.
	Broxbourne	,, 12	Rev. H. P. Waller.
	Odsey	,, 13	H. G. Fordham.
Swallow	Berkhamsted	April 6	Mrs. E. Mawley.
(*Hirundo rustica*)	Watford	,, 6	Mrs. Hopkinson.
	Hatfield	,, 10	Miss R. Blackett.
	Elstree	,, 11	E. P Thompson.
	Hitchin	,, 12	A. H. Foster.
	Sawbridgeworth	,, 14	H. S. Rivers.
	St. Albans	,, 15	H. Lewis.
	Broxbourne	,, 15	Rev. H. P. Waller.
	Harpenden	,, 17	J. J. Willis.
	Odsey	,, 17	H. G. Fordham.
	Bushey Heath	,, 22	P. J. Barraud.
	St. Albans (N.Fm.)	,, 23	A. W. Dickinson.
(Last seen)	Hatfield	Oct. 5	Miss R. Blackett.
	Watford	,, 7	Mrs. Hopkinson.
	Odsey	,, 13	H. G. Fordham.
	Broxbourne	,, 13	Rev. H. P. Waller.
	St. Albans (N.Fm.)	,, 15	A. W. Dickinson.
	,,	,, 20	H. Lewis.
	Sawbridgeworth	,, 20	H. S. Rivers.
	Berkhamsted	,, 23	Mrs. E. Mawley.
House-Martin	Elstree	April 24	E. P. Thompson.
(*Chelidon urbica*)	St. Albans	,, 26	H. Lewis.
	Bushey Heath	,, 28	P. J. Barraud.
Sand-Martin	Hitchin	,, 10	W. Hill.
(*Cotile riparia*)			
Swift	Bushey Heath	May 3	P. J. Barraud.
(*Cypselus apus*)	Hitchin	,, 4	A. H. Foster.
	St. Albans	,, 4	H. Lewis.
	Watford	,, 7	W. Bickerton.
	Elstree	,, 19	E. P. Thompson.
(Last seen)	St. Albans	Aug. 20	H. Lewis.
Nightjar	Hitchin	May 5	A. H. Foster.
(*Caprimulgus europæus*)			
Wryneck	Hitchin	April 5	C. Lucas.
(*Iynx torquilla*)	St. Albans	,, 11	H. Lewis.
	Elstree	,, 11	E. P. Thompson.
	Bushey Heath	,, 22	P. J. Barraud
Cuckoo	Broxbourne	,, 11	Rev. H. P. Waller.
(*Cuculus canorus*)	Watford	,, 14	Mrs. Hopkinson.
	St. Albans (N. Fm.)	,, 15	A. W. Dickinson.
	Hatfield	,, 15	Miss E. Blackett.
	Harpenden	,, 17	J. J. Willis.
	Bushey Heath	,, 23	P. J. Barraud.
	Elstree	,, 24	E. P. Thompson.
	Hitchin	,, 26	A. W. Dawson.
	Berkhamsted	,, 26	Mrs. E. Mawley.
	Sawbridgeworth	,, 29	H. S. Rivers.
	Odsey	May 1	H. G. Fordham.
Turtle-Dove	St. Albans (N.Fm.)	,, 6	A. W. Dickinson.
(*Turtur communis*)	,,	,, 7	A. Grey.
	Hitchin	,, 14	A. H. Foster.
	Haileybury	,, 17	F. W. Headley.
Corn-Crake	St. Albans (N. Fm.)	,, 8	A. W. Dickinson.
(*Crex pratensis*)			
Common Sandpiper	Watford	,, 7	W. Bickerton.
(*Totanus hypoleucus*)			

Winter Visitors.

Species.	Locality.	Date.	Observer.
Fieldfare (*Turdus pilaris*)	Haileybury	Oct. 18	F. W. Headley.
	Watford	Nov. 10	W. Bickerton.
Golden Plover (*Charadrius pluvialis*)	Haileybury	Oct. 30	M. Vaughan.

WEETWOOD, WATFORD, AFTER THE SNOW-STORM OF CHRISTMAS, 1906.

XIX.

THE WEATHER OF THE YEAR 1906 IN HERTFORDSHIRE.

By JOHN HOPKINSON, F.L.S., F.G.S., F.Z.S., F.R.Met.Soc., Assoc.Inst.C.E.

Read at Watford, 23rd April, 1907.

(PLATE X.)

THIS report gives results of observations at the same four meteorological stations as in 1905 and some years previously, and at 54 rainfall stations against 53 for 1905. From all these stations daily returns of the rainfall have been received, being a greater number than in any previous year.

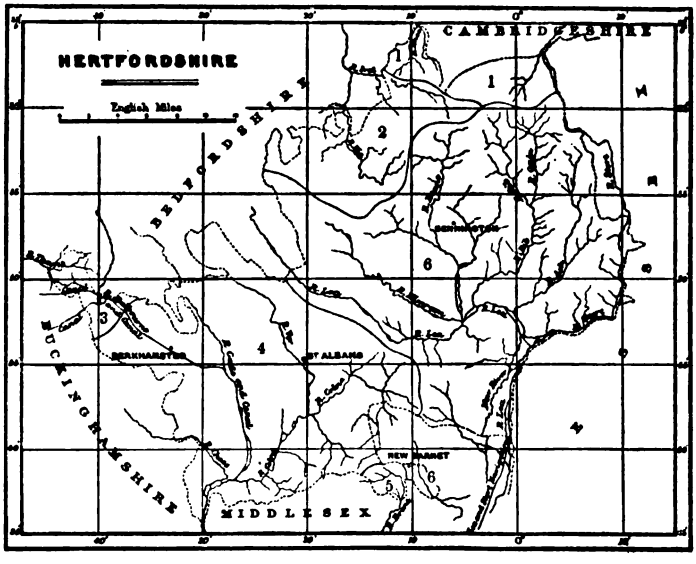


FIG. 6.—*Map of Hertfordshire showing its Meteorological Stations and River Basins.*

River Basins	1. Cam.	3. Thame.	5. Brent.
	2. Ivel.	4. Colne.	6. Lea.

There are a few changes to record in the rainfall stations in the principal table. The additions are: Cowroast Lock, Tring, in the Bulbourne river-district, and Frogmore near St. Albans, in the Ver (former stations re-inserted); the Grammar School, Barnet, in the Brent; Barley, in the Rib; Hadham Hall, in the Ash; and Haileybury College, Hertford, in the Upper Lea. The losses are: Pendley Manor, Tring, in the Upper Thame

district, and Holwell House, Hatfield, in the Upper Lea, removed to the supplementary table as the daily returns have not been received; Fairhill, Berkhamsted, in the Bulbourne, removed to that table owing to the daily record not being complete; Knebworth Manor House, in the Beane, discontinued through the removal of the observer; and Hillside, Buntingford, in the Rib, through the return not having been received. We thus gain one station in the Ver river-district, one in the Brent, and one in the Ash; and lose one in the Thame district and one in the Beane.

The supplementary rainfall table gives the annual rainfall collected by fifteen other gauges in the county. Five of these records are those of additional gauges at stations at which the rainfall is given in the principal table; four are those which have been omitted from that table for various reasons; and six are from 'British Rainfall,' 1906.

An alteration has been made in the symbols in the last column of the principal rainfall table and the fifth column of the supplementary table. They now are: B, altitude taken by barometer; L, altitude ascertained by levelling from an Ordnance Survey bench-mark; and T, altitude ascertained approximately from the same source. This has been done on account of the difficulty of satisfactorily making-up the former symbol representing a bench-mark, now altered to L, a symbol not before adopted as it has a different meaning in 'British Rainfall.'

The hour of observation is in all cases 9 a.m., and all the observations are entered to the same day except the rainfall and the maximum temperature, which are entered to the previous day. Shade temperatures only are given: those for Bennington, Berkhamsted, and St. Albans from thermometers in Stevenson screens, and those for New Barnet from thermometers under a Glaisher stand, showing a greater range but about the same mean.

TABLE I.—*Results of Climatological Observations taken in Hertfordshire in the Year* 1906.

Stations	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Bennington	49·2	41·6	56·8	15·2	15·8	91·8	81	7·3	24·56	185
Berkhamsted	49·3	41·0	57·6	16·6	16·5	92·3	80	7·0	28·73	186
St. Albans	49·5	41·9	57·1	15·2	18·9	92·7	80	6·9	28·70	185
New Barnet	51·1	42·2	60·0	17·8	20·2	94·9	79	6·0	27·05	170
County.....	49·8	41·7	57·9	16·2	15·8	94·9	80	6·8	27·26	181

Information as to the stations has been given in my paper on "The Climate of Hertfordshire" in the eleventh volume of our 'Transactions' (pp. 125–126). The averages with which the results are compared are those for the twelve years 1887–1898 as there given, except for the rainfall, which is compared with the average for the sixty years 1840–1899.

The year 1906 was very warm and rather wet; the air was dry and the sky of average brightness. Rain fell on a rather large number of days.

The mean temperature was 49·8°, being 1·5° above the average; the mean daily range was 16·2°, being 0·3° above the average, the excess of temperature thus being a little more due to the warmth of the days than to that of the nights. The rainfall was 26·49 inches, being 1·72 in. above the average for the decade 1890–99, and 0·34 in. above that for the 60 years 1840–99. The number of wet days was 172, being 4 more than the average for the 30 years 1870–99.

TABLE II.—*Means of Climatological Observations (with Extremes of Temperature) for the Year* 1906.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min	Max.	Range	Min	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·3	36·5	46·1	9·6	21·8	53·8	89	6·6	4·06	21
Feb.	37·7	32·2	43·2	11·0	21·7	51·0	90	6·9	2·25	21
March	41·2	34·3	48·1	13·8	21·7	65·6	83	6·7	1·56	18
April	45·4	34·2	56·6	22·4	23·7	74·8	70	5·1	·59	9
May	52·6	43·3	61·4	17·6	28·4	77·9	76	7·8	1·22	18
June	57·9	47·0	68·8	21·8	31·7	83·6	72	6·8	3·11	9
July	63·0	52·3	73·8	21·5	41·7	85·8	67	5·8	·85	8
August	64·7	53·8	75·5	21·7	40·7	95·3	71	5·9	1·10	8
Sept.	58·9	48·6	69·1	20·5	32·9	94·9	71	5·8	1·30	9
Oct.	52·8	46·0	59·5	13·5	30·7	71·7	90	7·4	4·62	21
Nov.	45·1	39·5	50·8	11·3	27·6	60·8	91	8·6	3·85	19
Dec.	36·4	31·5	41·3	9·8	15·8	55·6	89	8·2	2·75	20
Year	49·8	41·7	57·9	16·2	15·8	95·3	80	6·8	27·26	181

Compared with the average, July, September, and November were warm months; August and October were very warm; April, June, and December were rather cold. The air was dry in April, July, and August, rather dry in June, and very dry in September; it was moist in February. The sky was bright in January, April, July, and August; it was cloudy in May, October, November, and December. February, June, and November were wet months, December was rather wet, and January and October were very wet; May, August, and September were dry, and April and July were very dry; March had an average rainfall.

Rain fell on many days in January, February, May, October, and December; on few days in April, June, July, August, and September.

The winter of 1905–6 (Dec.–Feb.) was very mild, chiefly owing to the warmth of the nights, the mean daily range of temperature being small. The air was moist and the sky of about average brightness. The rainfall was heavy and very frequent.

The spring (March–May) was of about average temperature, and the mean daily range was about the average. The air was dry and the sky of average brightness. The rainfall was very small, but frequent.

The summer (June–August) was warm, owing chiefly to the warmth of the days, the mean daily range of temperature being great. The air was very dry and the sky rather bright. The rainfall was small and there were very few wet days.

The autumn (Sept.–Nov.) was very warm, owing a little more to the warmth of the days than to that of the nights, the mean daily range being slightly greater than usual. The air was rather dry and the sky cloudy. The rainfall was heavy and frequent.

TABLE III.—*Means of Climatological Observations (with Extremes of Temperature) for the Seasons of* 1905–1906.

Seasons	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Winter	39·5	34·7	44·3	9·6	21·7	56·8	91	7·4	7·31	56
Spring	46·4	37·3	55·4	17·9	21·7	77·9	76	6·5	3·37	45
Summer	61·9	51·0	72·7	21·7	31·7	95·3	70	6·2	5·06	25
Autumn	52·3	44·7	59·8	15·1	27·6	94·9	84	7·3	9·77	49

There was one "absolute drought" (a period of more than 14 days without a measurable quantity of rain) at all stations but two, extending over very various periods from near the end of March to about the middle of April—earlier at some stations, later at others. It is recorded to have lasted for 15 days (March 28 to April 11 or March 29 to April 12) at 9 stations; for 16 days (March 27 to April 11 or March 28 to April 12) at 13 stations; for 17 days (March 27 to April 12 or March 28 to April 13) at 9 stations; for 19 days (March 29 to April 16) at 2 stations; for 20 days (March 28 to April 16) at 3 stations; for 21 days (March 27 to April 16) at 10 stations; for 22 days (March 26 to April 16) at 4 stations; and for 25 days (March 27 to April 20 or March 29 to April 22) at

2 stations. It is probable that the records of some of these periods are longer than they should have been owing to slight falls of rain towards the end of the drought having been overlooked, and almost certain that such was the case in the recorded period of 25 days. The variations in the date of beginning and ending of the drought do not appear in any instance to be due to an entry of rainfall on a wrong day, as for the day of observation instead of the previous day, being accounted for by very slight falls of rain at some stations and not at others.

There was one "partial drought" (a period of more than 28 days with a mean rainfall not exceeding 0·01 in. per day), lasting 31 days (March 27 to April 26) at 20 stations, with an average fall of 0·008 in. of rain per diem, and 32 days (March 26 to April 26) at 9 other stations, with an average rainfall of 0·007 in. per diem. It thus prevailed at more than half the stations.

The maximum falls of rain in any one day in each month, and the stations recording them, were: Jan. 12, Kensworth, 0·74 in.; Feb. 16, Gorhambury, St. Albans, 0·48 in.; March 10, Gorhambury, 0·40 in.; April 23, Throcking, 0·29 in.; May 20, Barley, 0·43 in.; June 28, Rose Cottage, Berkhamsted, 2·70 ins.; July 27, Easby, Northwood, 1·55 in.; August 24, Cowroast, Apsley Mills, Rothamsted, and Easby, Northwood, 0·33 in.; Sept. 14, Barley, 0·60 in.; Oct. 1, Gorhambury, 1·17 in.; Nov. 8, Therfield, 1·52 in.; Dec. 16, Stanstead Abbotts, 0·95 in.

The day in each month on which a heavy fall of rain was most general over the county was: Jan. 12, Feb. 16, March 10, April 27, May 20, June 28, July 27, August 13, Sept. 14, Oct. 2, Nov. 8, Dec. 13 and 25; and in the year June 28 and Nov. 8, the mean fall on June 28 being 2·10 ins., and on Nov. 8, 1·05 in.

The rainfall reached at least one inch in 24 hours ending 9 a.m. on six occasions during the year: once in June, once in July, three times in October, and once in November. On one of these occasions, June 28, it exceeded two inches at most of the stations. There are in the aggregate 143 records of at least an inch, 35 of which exceeded two inches.

The total yearly fall ranged from 21·85 inches at the Hertford Sewage Works (an unusually small amount compared with that at neighbouring stations) to 30·58 inches at The Grove, Kensworth; and the total monthly fall from 0·30 in. at the London Orphan Asylum, Watford, in April, to 5·94 ins. at Cowroast Lock, Tring, in October. The greatest fall in any one day was 2·70 ins. at Rose Cottage, Berkhamsted, on 28th June.

The rainfall of the Thame and Colne districts considerably exceeded the mean for the county, and that of the Brent district and the Thames basin slightly exceeded it; that of the Cam district was greatly in defect of the county mean, that of the Ivel and Lea districts were slightly in defect, and that of the Ouse basin was considerably in defect.

TABLE IV.—*Climatological Observations taken at* BENNINGTON HOUSE, BENNINGTON. *Latitude*: 51° 53′ 45″ N. *Longitude*: 0° 5′ 20″ W. *Altitude*: 407 *feet*. *Observer*: REV. J. D. PARKER, LL.D., F.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	40·8	36·3	45·2	8·9	26·8	52·5	90	7·9	3·47	22
Feb.	37·1	31·9	42·4	10·5	26·4	47·0	93	7·3	1·66	19
March	40·5	33·7	47·2	13·5	25·2	63·8	89	6·9	1·51	17
April	44·9	34·6	55·2	20·6	28·9	69·8	71	5·6	·46	9
May	51·6	43·5	59·8	16·3	31·6	75·4	77	8·1	·96	18
June	57·3	46·9	67·7	20·8	36·1	78·3	73	7·3	3·35	9
July	62·6	52·4	72·7	20·3	43·9	79·7	67	6·7	·57	11
August	64·2	53·8	74·7	20·9	47·2	91·8	71	6·6	1·18	7
Sept.	58·8	49·3	68·3	19·0	40·9	91·5	69	6·5	1·19	10
Oct.	52·5	46·3	58·7	12·4	33·0	68·7	90	7·9	4·00	21
Nov.	44·6	39·5	49·6	10·1	28·3	59·1	92	8·8	3·77	21
Dec.	35·6	30·6	48·6	10·0	15·8	53·4	90	8·4	2·44	21
Year	49·2	41·6	56·8	15·2	15·8	91·8	81	7·3	24·56	185

TABLE V.—*Other Meteorological Observations taken at Bennington by the Rev. Dr. Parker.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	29·986	39·6	38·4	39·6	40·4	1	16	58	6·2	9
Feb.	·809	36·3	35·5	37·7	38·8	4	16	74	8·0	6
March	30·036	39·8	38·4	40·5	41·0	5	13	115	10·2	6
April	·115	46·5	42·4	45·6	45·7	5	6	218	12·5	1
May	29·906	52·2	48·7	51·9	51·2	0	19	134	13·2	4
June	30·149	58·1	53·4	59·6	58·8	2	7	216	14·8	0
July	·064	62·9	57·0	64·2	63·3	2	12	235	14·3	0
August	·025	64·2	58·9	64·9	64·5	4	10	222	12·5	0
Sept.	·227	59·6	54·1	60·7	61·5	5	10	194	11·7	1
Oct.	29·891	51·6	50·2	54·2	55·4	1	17	99	9·2	3
Nov.	·913	44·9	43·9	46·4	47·7	1	20	41	6·2	16
Dec.	·986	35·4	34·3	39·5	41·5	3	17	45	5·5	12
Year	30·009	49·2	46·3	50·4	50·8	32	165	1651	14·8	58

TABLE VI.—*Climatological Observations taken at* ROSEBANK, BERKHAMSTED. *Latitude:* 51° 45′ 40″ N. *Longitude:* 0° 33′ 30″ W. *Altitude:* 400 *feet. Observer:* EDWARD MAWLEY, F.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·5	36·6	46·3	9·7	23·7	52·7	89	7·0	4·05	20
Feb.	37·6	31·9	43·3	11·4	23·3	49·0	91	7·2	2·36	24
March	41·0	33·9	48·2	14·3	23·8	64·6	83	7·1	1·62	17
April	45·0	33·4	56·5	23·1	24·8	70·5	69	5·3	·83	9
May	51·7	43·1	60·4	17·3	28·4	74·5	76	7·8	1·19	21
June	57·3	46·4	68·1	21·7	35·5	77·7	73	6·9	3·55	9
July	61·9	51·2	72·7	21·5	41·7	80·9	67	6·1	·73	8
August	64·0	52·9	74·8	21·9	41·9	91·9	70	5·8	·84	9
Sept.	57·9	47·1	68·7	21·6	33·5	92·3	73	5·6	1·27	9
Oct.	52·3	45·4	59·2	13·8	31·9	69·8	92	7·9	5·70	21
Nov.	44·8	39·0	50·7	11·7	27·6	60·4	92	8·5	3·60	18
Dec.	36·2	30·6	41·8	11·2	16·5	54·2	89	8·2	2·99	21
Year	49·3	41·0	57·6	16·6	16·5	92·3	80	7·0	28·73	186

TABLE VII.—*Other Meteorological Observations taken at Berkhamsted by Mr. Mawley.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	29·968	39·7	38·3	39·4	40·9	2	12	63	5·8	4
Feb.	·787	35·7	34·8	37·5	39·4	3	12	81	7·4	5
March	30·023	40·1	38·0	41·3	42·2	5	11	116	10·2	4
April	·101	45·7	41·2	46·6	46·8	7	6	217	12·1	0
May	29·882	52·3	48·6	52·7	51·7	1	18	139	11·3	5
June	30·145	58·1	53·5	59·9	58·8	3	9	231	13·6	0
July	·051	63·1	57·2	63·7	62·7	2	6	243	12·9	1
August	·012	64·0	58·5	64·8	64·6	5	3	237	12·3	0
Sept.	·225	58·8	54·2	61·1	62·2	6	9	195	11·3	0
Oct.	29·863	51·1	49·9	54·3	55·8	1	16	92	9·3	4
Nov.	·897	44·5	43·5	46·0	48·0	1	16	48	7·0	10
Dec.	·978	35·4	34·3	38·8	42·0	3	17	50	5·8	12
Year	29·994	49·0	46·0	50·5	51·3	39	135	1712	13·6	45

TABLE VIII.—*Climatological Observations taken at the* HERTFORDSHIRE COUNTY MUSEUM, ST. ALBANS. *Latitude:* 51°45′15″N. *Longitude:* 0° 19′ 56″ W. *Altitude:* 389 *feet. Observer:* JOHN HOPKINSON, F.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	40·9	36·2	45·6	9·4	26·4	52·8	89	6·6	4·27	22
Feb.	37·4	32·2	42·5	10·3	25·4	47·8	90	7·1	2·59	21
March	40·6	34·4	46·9	12·5	24·6	63·7	83	6·8	1·66	19
April	45·3	34·9	55·8	20·9	28·0	71·5	70	5·3	·53	7
May	52·3	43·6	61·1	17·5	31·7	74·1	76	7·9	1·21	18
June	57·5	47·7	67·3	19·6	37·0	77·8	72	6·9	2·86	11
July	62·6	52·6	72·5	19·9	45·4	81·3	67	6·0	·60	7
August	64·0	54·1	74·0	19·9	45·9	92·7	70	6·1	1·70	8
Sept.	59·0	49·3	68·6	19·3	34·5	92·7	72	5·9	1·07	9
Oct.	52·3	46·0	58·7	12·7	33·0	68·7	90	7·5	5·31	22
Nov.	45·0	39·1	50·8	11·7	28·6	59·7	91	8·7	3·99	21
Dec.	36·6	32·1	41·1	9·0	18·9	52·6	89	8·3	2·91	20
Year	49·5	41·9	57·1	15·2	18·9	92·7	80	6·9	28·70	185

TABLE IX.—*Climatological Observations taken at the* GAS WORKS, NEW BARNET. *Latitude:* 51° 39′ 5″ N. *Longitude:* 0° 10′ 15″ W. *Altitude:* 212 *feet. Observer:* T. H. MARTIN, Assoc. M. Inst. C. E.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	42·0	36·7	47·2	10·5	21·8	53·8	88	4·4	4·47	21
Feb.	38·8	33·0	44·6	11·6	21·7	51·0	87	6·2	2·39	21
March	42·5	35·0	49·9	14·9	21·7	65·6	82	5·8	1·44	19
April	46·5	33·9	59·1	25·2	23·7	74·8	71	4·2	·53	9
May	54·7	45·1	64·3	19·2	30·2	77·9	75	7·3	1·51	15
June	59·6	47·0	72·0	25·0	31·7	83·6	71	6·0	2·66	8
July	65·2	53·0	77·4	24·4	42·2	85·8	68	4·6	1·50	6
August	66·5	54·4	78·5	24·1	40·7	95·3	71	5·3	·67	7
Sept.	60·0	48·9	71·0	22·1	32·9	94·9	74	5·2	1·74	10
Oct.	54·0	46·4	61·6	15·2	30·7	71·7	89	6·1	3·47	20
Nov.	46·1	40·2	52·0	11·8	27·7	60·8	89	8·4	4·03	16
Dec.	37·3	32·7	41·8	9·1	20·2	55·6	87	7·9	2·64	18
Year	51·1	42·2	60·0	17·8	20·2	94·9	79	6·0	27·05	170

TABLE X.—HERTFORDSHIRE RAINFALL STATIONS, 1906.

District.	STATION.	OBSERVER or AUTHORITY.	Diameter of Gauge.	Height of Gauge above Ground.	Height of Gauge above Sea-level.	
			ins.	ft. ins.	ft.	
1.	Royston—Melbourne Street	Joseph E. J. Phillips	8	0 11	201	T
,,	Odsey	H. George Fordham	5	1 0	256	L
2.	Baldock—High Street	F. W. Langston Day	5	1 0	214	L
3.	Preston—The Laburnums	R. de V. Pryor	8	2 6	480	L
,,	Hitchin—Wratten	William Lucas	5	2 1	238	L
,,	,, The Maples	William Hill	8	1 1	221	T
,,	,, The Chilterns	Francis Ransom	5	0 10	300	L
,,	,, High Down	Joseph Pollard	5	1 1	422	L
4.	Tring—Bulbourne	Gordon C. Thomas	5	2 3	401	
5.	Croxley Green—Chess Side	S. Ingleby Oddie	5	0 7	250	T
6.	Tring—Cowroast Lock	Gordon D. Thomas	5	3 8	394	L
,,	Berkhamsted—Rosebank	Edward Mawley	8	1 0	401	L
,,	,, Rose Cottage	W. E. Milner	5	1 0	334	L
7.	H. Hempstead—Apsley Mills	J. Dickinson & Co.	24	1 4	260	
8.	Kensworth—The Grove	Miss S. Grace Jones	5	1 5	630	B
,,	Harpenden—Rothamsted	A. D. Hall	5	0 9	420	T
,,	St. Albans—Gorhambury	W. Newberry	5	1 0	423	T
,,	,, Herts County Museum	John Hopkinson	5	1 0	389	L
,,	,, Bone Hill	H. J. T. Broadwood	5	1 0	336	L
,,	Frogmore—The Cottage	Arthur B. Lipscomb	5	0 10	218	T
9.	St. Albans—Hill End Asylum	George Goodchild	5	1 0	295	T
,,	Elstree—Aldenham House	Edwin Beckett	10 sqr.	4 9	305	
10.	Watford—Weetwood	John Hopkinson	5	1 0	269	L
,,	,, Lond. Orph. Asylum	Rev. Dr. O. C. Cockrem	5	1 0	231	T
,,	,, Colne Valley W. Wks.	William Verini	5	1 2	220	
,,	Rickmansworth—Moor Park	Lord Ebury	5	2 0	340	L
,,	Eastbury—Valency House	H. Langford Lewis	5	1 0	360	T
,,	Northwood—Easby	Mrs. S. Fawcett	8	0 10	400	T
11.	Barnet—Summerhill	F. A. Milne	5	0 10	400	
,,	,, Grammar School	Rev. J. B. Lee	5	1 3	430	T
12.	Welwyn—Danesbury	Col. A. M. Blake, C.B.	8	1 0	400	
,,	,, Bridge House	Dr. B. Wilfred Thomas	5	2 3	216	
,,	Datchworth Rectory	Rev. Andrew Amos	5	1 0	372	L
13.	Weston—Weston Park	M. R. Pryor	5	0 8	470	T
,,	Bennington—Eileen Cottage	A. B. Legard	5	1 0	408	
,,	,, Bennington House	Rev. Dr. J. D. Parker	5	1 0	406	L
14.	Barley	William W. Cook	5	1 0	249	
,,	Therfield Rectory	Rev. John G. Hale	5	4 3	510	L
,,	Throcking Rectory	Rev. C. W. Harvey	5	1 0	487	L
,,	Buntingford—Hamels Park	H. Shepherd Cross	5	1 3	390	T
15.	Lit. Hadham—Hadham Hall	William Minet	5	0 10	338	
,,	Much Hadham	T. Woodham Mott	5	1 0	220	B
16.	Harlow—Gilston Park	Edward Leach	8	0 6	175	T
17.	Hertford—Bayfordbury	H. W. Clinton Baker	8	1 2	250	
,,	,, Haileybury College	P. H. Latham	8	1 0	270	T
,,	,, Sewage Works	Metrop. Water Board	8	6 0	121	
,,	Ware—Fanhams Hall	Miss V. M. Croft	8	1 0	210	T
,,	,, Red House	Metrop. Water Board	5	4 0	115	T
,,	Stanstead Abbotts	E. H. Barlow	5	1 2	115	T
18.	Hoddesdon—Feildes Weir	Metrop. Water Board	8	3 8	95	
,,	Broxbourne—Stafford House	G. J. Newbery	5	1 0	118	T
,,	Newgate St.—Hatfield St. M.	Rev. H. W. Southey	5	0 10	350	
,,	Northaw—St. Just	Miss E. J. Poland	5	1 0	385	
,,	New Barnet—Gas Works	T. H. Martin	8	1 0	212	

TABLE XI.—RAINFALL

River District.			Station.	Jan.	Feb.	Mar
				ins.	ins.	ins.
OUSE	CAM	1. Rhee	Royston—Melbourne Street	2·60	1·72	1·99
			Odsey	2·65	1·52	1·61
	IVEL	2. Upper Ivel	Baldock—High Street	2·90	1·77	1·97
		3. Hiz	Preston—The Laburnums	3·63	1·99	2·03
			Hitchin—Wratten	3·54	1·63	1·83
			,, The Maples	3·20	1·71	1·95
			,, The Chilterns	3·43	1·65	1·93
			,, High Down	3·16	1·56	1·81
	THAME	4. Up. Thame	Tring—Bulbourne	3·79	1·89	1·70
THAMES		5. Chess	Croxley Green	4·57	2·30	1·50
	COLNE	6. Bulbourne	Tring—Cowroast Lock	4·25	2·34	1·75
			Berkhamsted—Rosebank	4·05	2·36	1·62
			,, Rose Cottage	4·13	2·34	1·59
		7. Gade	Hemel Hempstead—Apsley Mills	4·27	2·59	1·70
		8. Ver	Kensworth—The Grove	4·02	2·25	2·17
			Harpenden—Rothamsted	4·04	2·28	1·54
			St. Albans—Gorhambury	4·13	2·42	1·48
			,, Herts County Museum	4·27	2·59	1·60
			,, Bone Hill	3·85	2·31	1·55
		9. Up. Colne	Frogmore—The Cottage	4·20	2·42	1·64
			St. Albans—Hill End Asylum	3·75	2·26	1·30
			Elstree—Aldenham House	4·32	2·22	1·28
		10. Lo. Colne	Watford—Weetwood	4·46	2·38	1·42
			,, London Orphan Asylum	4·30	2·33	1·20
			,, Colne Valley Water Works	4·21	2·19	1·15
			Rickmansworth—Moor Park	3·85	2·01	1·42
			Eastbury—Valency House	3·89	1·97	1·31
			Northwood—Easby	4·14	2·16	1·42
	BRENT	11. Up. Brent	Barnet—Summerhill	4·61	2·14	1·43
			,, Grammar School	4 15	2·27	1·54
			Welwyn—Danesbury	3·71	2·13	1·83
		12. Mimram	,, Bridge House	3·90	2·34	1·87
			Datchworth Rectory	3·83	1·76	1·57
		13. Beane	Weston—Weston Park	3·36	1·91	1·74
			Bennington—Eileen Cottage	3·80	1·94	1·74
			,, Bennington House	3·47	1·66	1·51
			Barley	4·16	2·31	2·27
		14. Rib	Therfield Rectory	2·93	1·77	1·87
			Throcking Rectory	3·40	1·69	1·72
			Buntingford—Hamels Park	3·45	2·08	1·79
	LEA	15. Ash	Little Hadham—Hadham Hall	3·51	1·96	1·52
			Much Hadham	3·46	1·84	1·42
		16. Stort	Harlow—Gilston Park	3·84	2·08	1·73
			Hertford—Bayfordbury	3·70	2·16	1·45
			,, Haileybury College	3·69	1·93	1·30
			,, Sewage Works	3·05	1·58	1·16
		17. Upper Lea	Ware—Fanhams Hall	3·37	1·92	1·62
			,, Red House	3·62	1·86	1·33
			Stanstead Abbots	3·54	1·71	1·26
			Hoddesdon—Feildes Weir	3·48	1·85	1·23
		18. Lower Lea	Broxbourne—Stafford House	4·38	2·27	1·60
			Newgate St.—Hatfield St. Mary's	3·81	1·87	1·30
			Northaw—St. Just	4·22	2·34	1·49
			New Barnet—Gas Works	4·47	2·39	1·44
			Mean for the County	3·79	2·05	1·60

HERTFORDSHIRE IN 1906.

APL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.	DAYS.
ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	
·90	1·02	3·34	·57	1·03	1·05	3·58	3·94	2·13	23·87	170
1·06	1·15	3·56	·79	·82	1·17	3·54	4·25	2·00	24·12	187
·95	1·19	4·77	·42	·90	1·36	3·69	4·11	2·04	26·07	156
·72	1·03	3·78	·84	·98	1·32	3·92	4·00	2·64	26·88	171
·66	·99	3·81	·55	·88	1·13	4·19	4·02	2·21	25·44	171
·70	1·03	3·85	·56	·89	1·16	4·05	3·88	2·20	25·18	179
·71	1·03	3·75	·79	1·17	1·43	4·17	3·96	2·44	26·46	176
·58	1·20	3·72	·73	·76	1·00	4·03	3·42	2·04	24·01	178
·72	1·29	3·33	·49	1·18	1·32	5·42	3·76	2·35	27·24	184
·48	1·50	2·31	·77	1·26	1·44	5·11	3·68	2·79	27·71	149
·96	1·28	3·21	·57	1·17	1·42	5·94	3·53	3·01	29·43	144
·83	1·19	3·55	·73	·84	1·27	5·70	3·60	2·99	28·73	172
·87	1·20	3·48	·81	·85	1·29	5·75	3·62	2·89	28·82	174
·70	1·41	2·26	·50	1·13	1·31	5·72	3·76	2·95	28·30	191
·68	1·63	3·54	·76	1·02	1·34	5·22	4·63	3·32	30·58	177
·74	1·33	3·42	·38	1·17	1·07	5·16	4·08	2·80	28·01	170
·49	1·35	2·90	·81	1·34	1·06	5·67	4·20	2·95	28·80	146
·53	1·21	2·86	·60	1·70	1·07	5·31	3·99	2·91	28·70	185
·57	1·61	2·68	·92	1·55	1·22	5·12	3·87	2·92	28·17	183
·64	1·26	2·86	·89	1·42	1·26	4·89	4·00	2·86	28·34	188
·53	·97	3·11	·54	1·25	1·00	4·63	3·97	2·32	25·69	148
·50	1·40	2·80	·80	·70	1·46	4·20	4·08	2·10	25·86	144
·48	1·65	2·76	1·70	1·19	1·55	4·92	4·05	2·82	29·38	191
·30	1·55	2·42	1·42	1·14	1·39	4·72	3·76	2·33	26·92	166
·39	1·41	2·43	·72	1·17	1·46	4·17	3·54	2·33	25·17	166
·44	1·34	2·21	1·25	1·03	1·32	3·92	3·65	2·00	24·44	178
·45	1·37	2·86	1·34	·93	1·48	4·10	3·92	2·24	25·86	168
·47	1·46	2·39	1·87	1·10	1·51	4·03	3·88	2·80	27·23	172
·39	1·41	3·37	1·08	·51	1·60	3·27	3·69	2·47	25·97	156
·57	1·43	3·26	1·36	·73	1·86	3·44	4·22	2·67	27·50	192
·45	1·10	3·20	·60	1·41	1·07	4·42	3·99	3·02	26·93	168
·52	1·25	3·22	·69	1·58	1·20	4·85	4·16	3·15	28·73	167
·48	1·14	3·15	·91	1·21	1·31	4·08	3·69	2·47	25·60	
1·02	1·28	3·89	·78	1·02	1·55	3·99	4·46	2·35	27·35	198
·67	1·43	3·27	·73	1·06	1·31	4·08	4·04	2·68	26·75	185
·46	·96	3·35	·57	1·18	1·19	4·00	3·77	2·44	24·56	185
1·06	1·41	3·17	1·15	·87	1·49	3·91	4·32	2·83	28·95	176
1·10	1·24	3·47	·83	1·09	1·63	3·75	4·63	2·38	26·69	181
1·08	1·14	3·29	1·00	·91	1·36	3·68	3·95	2·57	25·79	187
·36	1·20	2·91	1·34	·57	1·29	4·53	4·39	2·79	26·70	167
·55	1·03	3·33	·70	·90	1·15	4·14	4·14	2·51	25·44	167
·56	·94	3·13	·84	·73	1·08	4·25	3·86	2·70	24·81	166
·79	1·12	3·21	1·15	·64	1·29	3·94	4·11	3·25	27·15	156
·35	1·11	3·12	·98	·71	1·46	4·29	3·73	2·75	26·01	180
·40	1·06	3·15	·90	·47	1·37	4·28	3·77	2·56	24·88	166
·34	·72	2·61	1·17	·69	1·12	4·23	3·38	1·80	21·85	
·49	1·12	2·83	1·50	·76	·90	3·48	3·65	2·49	24·13	165
·41	·87	2·98	1·48	·66	1·22	4·28	3·69	2·43	24·83	169
·42	·98	3·05	·92	·49	1·40	4·04	3·73	2·75	24·29	
·53	·94	2·54	1·11	·55	1·32	3·77	3·59	2·38	23·29	164
·60	1·17	3·38	1·56	·69	1·62	4·32	4·65	2·69	28·93	174
·46	1·28	3·41	·23	·66	1·42	4·06	4·07	2·32	24·89	188
·46	1·39	3·33	·80	·74	1·58	4·16	4·30	1·58	26·39	
·52	1·51	2·66	1·50	·68	1·73	3·47	4·03	2·65	27·05	170
·59	1·23	3·15	·93	·96	1·32	4·36	3·95	2·56	26·49	172

TABLE XII.—SUPPLEMENTARY TO TABLES I AND II.

District.	Station.	Observer.	Gauge. Diameter.	Gauge. Height above Sea.	Rainfall.	Days.
			ins.	feet.	ins.	
1.	Royston—Workhouse	J. W. Wesson	5	217	25·42	175
,,	,, Earlshill House	J. Phillips	8	225 T	25·31	188
4.	Wigginton Vicarage	Rev. H. J. Burrell	5	710 L	28·93	124
,,	Tring—Elm House	E. J. Le Quesne	5	460	26·94	166
,,	,, Grove Lodge	Miss Boyson	8	450	28·28	159
,,	,, Pendley Manor	Mrs. Williams	5	420	31·01	187
6.	Berkhamsted—Fairhill	W. B. Hopkins	5	548 L	27·49	
,,	,, Rosebank (M)	E. Mawley	8	401 L	28·04	
,,	,, Rose Cottage (M)	W. E. Milner	5	334 L	28·76	
7.	Chipperfield—L. Callipers	A. W. Rivington	5	407 T	26·08	107
8.	Harpenden—Rothamsted	A. D. Hall	8	420 T	26·85	161
,,	,, ,,	,,	72 × 87	420 T	28·95	175
10.	Watford—Weetwood (M)	J. Hopkinson	5	269 L	29·30	
14.	Buntingford—Westmill	T. Greg	5	279 T	26·37	199
17.	Hatfield—Holwell House	W. E. Laurie	5	240 T	23·90	165

M = gauge read monthly, in each case a second gauge.

The mean rainfall in each of the minor river-districts was: *Cam*: (1) Rhee, 24·00 ins. *Ivel*: (2) Upper Ivel, 24·12 ins.; (3) Hiz, 25·59 ins. *Thame*: (4) Upper Thame, 27·24 ins. *Colne*: (5) Chess, 27·71 ins.; (6) Bulbourne, 28·99 ins.; (7) Gade, 28·30 ins.; (8) Ver, 28·77 ins.; (9) Upper Colne, 25·78 ins.; (10) Lower Colne, 26·50 ins. *Brent*: (11) Upper Brent, 26·41 ins. *Lea*: (12) Mimram, 27·09 ins.; (13) Beane, 26·22 ins.; (14) Rib, 27·03 ins.; (15) Ash, 25·13 ins.; (16) Stort, 27·15 ins.; (17) Upper Lea, 24·27 ins.; (18) Lower Lea, 26·11 ins.

TABLE XIII.—RAINFALL IN THE RIVER-DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	BRENT.	LEA.	OUSE.	THAMES
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	2·63	3·31	3·79	4·14	4·38	3·67	3·14	3·90
Feb.	1·62	1·72	1·89	2·83	2·20	1·97	1·69	2·12
March	1·80	1·92	1·70	1·50	1·49	1·58	1·89	1·55
April	·98	·72	·72	·53	·48	·59	·78	·56
May	1·18	1·08	1·29	1·38	1·42	1·14	1·08	1·25
June	3·45	3·95	3·13	2·85	3·31	3·15	3·82	3·04
July	·68	·65	·49	·97	1·22	·98	·66	·97
August	·93	·93	1·18	1·16	·62	·84	·93	·97
Sept.	1·11	1·23	1·32	1·31	1·73	1·34	1·20	1·34
October	3·56	4·01	5·42	4·44	3·36	4·08	3·90	4·44
Nov.	4·09	3·90	3·76	3·89	3·95	4·01	3·95	3·95
Dec.	2·07	2·26	2·35	2·70	2·57	2·56	2·21	2·61
Year	24·00	25·68	27·24	27·68	26·73	25·91	25·25	26·70
Diff. from 1880–99	+1·19	+1·24	−1·03	+0·15		+1·16	+1·40	+0·52

The rainfall in Hertfordshire continues to be in excess of that of the adjoining counties. Comparing the mean for the whole of the gauges in each of these counties in 'British Rainfall,' 1906, the result is: Cambridgeshire (46 gauges), 23·34 ins.; Bedfordshire (27 gauges), 24·23 ins.; Buckinghamshire (34 gauges), 26·74 ins.; Middlesex, excluding London (50 gauges), 26·73 ins.; and Essex (83 gauges), 23·58 ins. The mean rainfall for all these gauges (240) is 24·35 ins. The mean for Hertfordshire (for the 67 gauges in 'British Rainfall') is 26·54 ins., showing an excess over the average rainfall in the adjoining counties of over 2 inches in amount and 11 per cent. in proportion.

The chief meteorological occurrences in the year were severe thunderstorms on the 10th of February and the 27th of July, the latter with heavy rain which caused floods; the great rainfall of the 28th of June; the intense heat at the end of August and the beginning of September; and the snow-storm at Christmas. Further mention of these phenomena will be made in the following notes on the character of the weather in each month. When Watford, St. Albans, or Berkhamsted are mentioned without the name of the station being given, it must be understood that they refer respectively to Weetwood, the Hertfordshire County Museum, and Mr. Mawley's meteorological station, Rosebank.

Notes on the Months.

JANUARY.—The weather was very mild, with an atmosphere of about average humidity, a bright sky, and an excessively heavy rainfall on a large number of days. Both days and nights were much warmer than usual, the mean daily range of temperature being about the average. The only cold period was from the 19th to the 24th; the last week was very warm. The minimum temperature was below 32° on only about a quarter the number of days in the month. The rainfall was nearly double the average and greater than in any January since 1877, and rain or snow fell nearly every day for the first 25 days at all stations, and every day during this period at one or other. The 4th was the wettest day at 11 stations, the 5th at 6, the 12th at 35, and the 6th and 12th were the wettest at 2 stations. The rainfall exceeded half an inch at 12 stations on the 4th, at 25 on the 5th, and at 36 on the 12th. The wind was very strong during the first half of the month, and the 6th was the most windy day in the year, the mean velocity throughout the day at Berkhamsted being 21 miles an hour.

FEBRUARY.—Of average temperature, with a humid atmosphere, a sky of average brightness, and a rather heavy rainfall on a large number of days. The mean daily range of temperature was small for the month, the nights being a little warmer and the days a little colder than usual. The first two days were very warm, but with this exception the last half of the month was

considerably warmer than the first half. The minimum temperature was below 32° on more than half the number of days in the month. Up to the 20th there was not a day without rain, snow, or hail at one station or other. The 16th was the wettest day at every station, but one, the 9th, was equally wet. On the 8th there was a severe, short, and remarkably sudden thunderstorm. At Watford, at about 2·25 p.m., a few very distant peals of thunder were heard, and at 2·28 there came a vivid flash of lightning with almost instantaneous thunder, and rain, sleet, hail, and then snow followed. The storm only lasted here for seven minutes, but the snow continued for some time, leaving the ground white until the following day. A horse in Watford was struck by the lightning and killed instantaneously, most probably by the first flash, remaining as it stood quite rigid after the cart in which it was harnessed had been removed. The man with it was also struck, and knocked down, but soon recovered from the shock. At Berkhamsted, Mr. Mawley says, there occurred between 2 and 3 "a sudden sharp squall of wind, rain, hail, snow, and sleet, during which the lightning was very vivid, and, judging by the short interval between the lightning and thunder, the centre of the disturbance must have passed almost directly over" the town. It apparently broke directly over Watford, and thence travelled to Berkhamsted. Mr. P. H. Latham reports that the storm, with snow and hail, came on at Haileybury College, Hertford, at 2.35 p.m. It is also reported from Hitchin and Harpenden as severe and accompanied by snow and hail.

March.—A month of average weather in almost all respects, the mean temperature, relative humidity, and cloud being exactly the average for our period, and the rainfall a very little below the average but on rather more than the average number of days. The only exceptional features were the small mean daily range of temperature, the days being colder and the nights warmer than usual, and the excessive warmth of two days, the 6th and 7th, the mean temperature of the former at St. Albans being 51·2°, and of the latter 52·7°, and the maximum on each day being 63·7°. The three days 15th to 17th, after a fortnight's cold weather, and the last day in the month, were also very warm, the temperature being variable throughout the month, and the seven very warm days having an appreciable effect in bringing up the mean temperature to the average. At one or other station rain or snow, sometimes with hail, fell every day from the 8th to the 28th, the falls of snow being very slight, except on the 13th, when the snow was an inch deep. The 1st was the wettest day at 2 stations, the 10th at 37, the 20th at 8, and the 25th at 7.

April.—A little colder than usual, with an exceedingly dry atmosphere, a very bright sky, and a very small rainfall on very few days, nearly all after the 20th. The mean daily range of temperature was unusually great, the nights being much colder

than usual and the days rather warmer. On several days the range of temperature exceeded 30°, and on the 11th, at St. Albans, it reached 35·5°. The first half of the month was much warmer than the second half. Three days, the 11th, 12th, and 13th, were exceptionally warm, their mean temperature at St. Albans being respectively 53·7°, 55·5°, and 55·4°, and their maximum 71·6°, 71·5°, and 68·7°. The temperature at 9 a.m. on the 12th was 58·8°, and on the 13th 57·8°. The minimum was below 32° on about a quarter the number of days in the month. A little snow fell on a few days towards the end of the month, the heaviest fall being on the 23rd, on which day the Rev. C. W. Harvey reports the depth at Throcking Rectory as 3 inches. The 22nd was the wettest day at one station, the 23rd at 8 stations, the 27th at 40, and the 30th at 5. A thunderstorm on the 12th is reported from Odsey, with very little rain.

MAY.—Of about average temperature and humidity, with a very cloudy sky, and a rather small rainfall, but on a large number of days. The mean daily range of temperature was unusually small, the nights being warmer and the days colder than usual. On the 1st only was the minimum below 32°. The temperature was very variable throughout the month. On three days the maximum was unusually high: the 8th, 74·0°, the 13th, 72·0°, and the 28th, 71·0° (at St. Albans). There was a severe but very local thunderstorm on the 8th, between Watford and St. Albans and in their neighbourhood.* This was the wettest day at one station (Bone Hill, St. Albans), the 20th was the wettest at 35 stations, the 26th at 12, the 30th at 2, the 20th and 26th were the wettest at 3 stations, and the 26th and 30th were the wettest at one station.

JUNE.—Rather cold, with a dry atmosphere, a sky of average brightness, and a heavy rainfall, but on a small number of days. The mean daily range of temperature was considerable, the nights being colder in relation to the average than were the days. On the 5th and the 7th there were frosts on the ground, and on the latter day the range in shade-temperature was as much as 33·5°. The 10 days ended 28th were very warm; the last two days were cold. There was a thunderstorm on the 1st with nearly half an inch of rain at some stations, and another on 23rd, apparently local, being recorded only at Weetwood, Watford, with very little rain. The 28th was the wettest day at all stations, the rainfall at every one exceeding an inch. In the *Cam* river-district it was 2·06 ins. at Royston, and 2·08 ins. at Odsey. In the *Ivel*, 2·43 ins. at Baldock, 2·46 ins. at High Down, Hitchin, 2·64 ins. at Preston, 2·65 ins. at The Maples, Hitchin, and 2·69 ins. at Wratten, Hitchin, and at The Chilterns, Hitchin. In the *Thame*, 2·21 ins. at our only station,

* Local in Hertfordshire, but in the Thames Valley, from Reading to London, it was heavy, with much rain in places. See 'Meteorological Magazine,' vol. xli, p. 65, and 'British Rainfall,' 1906, p. 9.

Bulbourne. In the *Colne*, 1·43 in. at Moor Park, 1·44 in. at Apsley Mills, 1·50 in. at Croxley Green, 1·69 in. at Bone Hill, St. Albans, 1·72 in. at Easby, Northwood, 1·82 in. at the Colne Valley Water Works, Watford, 1·83 in. at Valency House, Eastbury, 1·90 in. at the London Orphan Asylum, Watford, 1·91 in. at the Herts County Museum, St. Albans, 2·00 ins. at Frogmore, 2·02 ins. at Weetwood, Watford, 2·04 ins. at Gorhambury, St. Albans, and at Aldenham House, Elstree, 2·30 ins. at Kensworth, 2·32 ins. at Rothamsted, Harpenden, 2·33 ins. at Hill End Asylum, St. Albans, 2·37 ins. at Cowroast Lock, Tring, 2·64 ins. at Rosebank, Berkhamsted, and 2·70 ins. at Rose Cottage, Berkhamsted. In the *Brent*, 2·42 ins. at the Grammar School, Barnet, and 2·61 ins. at Summerhill, Barnet. And in the *Lea* district, 1·50 in. at the Red House, Ware, 1·56 in. at Gilston Park, 1·65 in. at Feilde's Weir, Hoddesdon, 1·70 in. at Hamels Park, 1·75 in. at Barley, 1·85 in. at Hertford Sewage Works, 1·86 in. at the Gas Works, New Barnet, 1·90 in. at Much Hadham, 1·98 in. at Fanhams Hall, Ware, 2·04 ins. at Danesbury, Welwyn, and at Therfield Rectory, 2·06 ins. at Eileen Cottage, Bennington, 2·08 ins. at Hadham Hall, 2·09 ins. at Stanstead Abbotts, 2·12 ins. at Bridge House, Welwyn, 2·14 ins. at Datchworth Rectory, 2·21 ins. at Bennington House, 2·25 ins. at Throcking Rectory, 2·30 ins. at Haileybury College, Hertford, and at Broxbourne, 2·42 ins. at Bayfordbury, Hertford, and at Hatfield St. Mary's, Newgate Street, 2·44 ins. at Weston Park, Stevenage, and 2·51 ins. at St. Just, Northaw. This fall, although rightly attributed to the 28th, did not commence until 10 p.m. on that day, and lasted until noon on the 29th without any intermission. The measurement at 9 a.m. on the day of observation, entered to the 28th, averaged throughout the county 2·10 ins., and after that hour, entered to the 29th, 0·20 in., giving 2·30 ins. for the 14 hours' continuous fall. At Kensworth Miss Grace Jones reports the whole amount (2·30 ins.) as having fallen between 10 p.m. on 28th and 9 a.m. on 29th, and at Haileybury Mr. Latham gives it as heavy only from 0·45 to 9 a.m.

JULY.—Very warm, with an exceedingly dry atmosphere, a very bright sky, and a very small rainfall on very few days. The days were about three times as much warmer than the average than were the nights, giving a great mean daily range of temperature. The warmest period was from the 22nd to the end of the month, and the last two days were excessively warm, the mean temperature at St. Albans on the 30th being 69·2°, and on the 31st 70·3°, and the maximum, 81·3° and 79·8° respectively: at 9 a.m. on the 30th the reading was 73·7°. Very little rain fell until the 26th, though at a few stations the wettest day occurred before that date. This day was the 5th at Bennington House, the 6th at Baldock, the 11th at 5 stations, and the 12th at Odsey, all due to thunderstorms. The 26th was the wettest day at 6 stations and the 27th at 40. The rainfall exceeded half an inch at 2 stations on the 26th and

at 21 on the 27th, on which day it exceeded three-quarters of an inch at 12 of these and an inch at 6 of the 12: 1·05 in. at Valency House, Eastbury, 1·12 in. at Fanhams Hall, Ware, 1·15 in. at the London Orphan Asylum, Watford, 1·28 in. at Broxbourne, 1·36 in. at Weetwood, Watford, and 1·55 in. at Easby, Northwood. This fall was caused by a severe thunderstorm in the afternoon, commencing just after one o'clock. At Watford the rain was so heavy that the High Street and some other streets were converted into rivers, the station was flooded, and the Fire Brigade had to be called out to pump the water from the electric light works. In Cassiobury Park three sheep sheltering under a lime-tree were killed by the lightning, and the stone cross on the western end of the old chapel of Cassiobury House was shattered into fragments, which in falling damaged the roof. Some parts of Rickmansworth also were flooded, and a house there was struck by the lightning and the roof damaged. At Berkhamsted for five minutes during the storm, rain was falling at the mean rate of over an inch an hour. At Weetwood, Watford, the rain commenced at 0·55 p.m., and at 1·50, when the storm ceased, had reached 1·32 in., being at the rate of 1·44 in. per hour for the whole time.

AUGUST.—Exceedingly warm, with a dry atmosphere, a bright sky, and a very small rainfall on very few days. The days were about twice as much warmer than the average than were the nights, giving, as in July, a great mean daily range of temperature. The weather became somewhat cooler on the 9th and warmer again on the 21st. The air was extremely dry on the 2nd. The 2nd, 8th, 22nd, and 30th were very warm days, and the 31st was excessively warm, the temperature at St. Albans at 9 a.m. being 80·1°, and the maximum 92·7°. The coldest night in the month was, however, that of the 29th–30th. At Berkhamsted the thermometer exposed on the lawn registered within 2° of frost. The range of temperature in the shade at St. Albans on the 31st was very great (38·0°). This was the commencement of a brief hot period which extended into the first few days of September. On only one day after the 17th was there an appreciable fall of rain. This was the 24th, which had an average throughout the county of about a quarter of an inch. On the 2nd and 16th there were local thunderstorms. The 2nd was the wettest day at one station (Bulbourne), the 15th at 29 stations, and the 24th at 24. The 13th was the only day on which the rainfall reached half an inch, at 9 stations only.

SEPTEMBER.—Very warm, with an exceedingly dry atmosphere, a sky a little brighter than usual, and a very small rainfall on very few days. The days were about three times as much warmer than the average than were the nights, giving a considerable mean daily range of temperature. The early part of the month was very warm, and the first three days were excessively so. The weather became much cooler on the 9th, and on the 11 the exposed thermometer on the lawn at

Berkhamsted registered 5° of frost. Very nearly all the rain in the month fell on the 4th and from the 12th to the 21st. There was a thunderstorm on the 16th. The 4th was the wettest day at 16 stations, the 13th at 12, the 14th at 21, and the 16th at 5. The following readings (at St. Albans) give the temperature for the hottest week in the year, and show how rapidly it rose and fell:—

			°		°		°		°	°
August	29, 9 a.m.		61·5	... min.	45·7	... max.	75·7	... mean	60·7*	(61·0†)
,,	30	,,	62·9	... ,,	49·5	... ,,	82·3	... ,,	66·3	(65·0)
,,	31	,,	75·2	... ,,	54·7	... ,,	92·7	... ,,	73·7	(74·2)
Sept.	1	,,	83·3	... ,,	59·3	... ,,	91·9	... ,,	75·6	(78·2)
,,	2	,,	78·7	... ,,	58·5	... ,,	92·7	... ,,	75·7	(76·8)
,,	3	,,	79·0	... ,,	54·5	... ,,	87·9	... ,,	71·2	(73·8)
,,	4	,,	65·9	... ,,	57·1	... ,,	74·3	... ,,	65·7	(65·8)

October.—Very warm, with a moist atmosphere, a cloudy sky, and a very heavy rainfall on a large number of days. The mean daily range of temperature was rather less than usual, owing to the greater excess over the mean in the night than in the day. The first half of the month was much warmer than the second half, or rather the first 13 days than the last 7, the intermediate period being very variable in temperature. The rain was distributed fairly equably over the month. The 1st was the wettest day at 13 stations, the 2nd at 29, the 18th at 10, and the 29th at 2. The rain on the 1st and 2nd was one continuous fall, commencing on the evening of the first. Up to 9 a.m. on the following morning it reached at least half an inch at 27 stations, three-quarters of an inch at 12 of these, and an inch at 5 of the 12: 1·00 in. at Rose Cottage, Berkhamsted, 1·01 in. at Rothamsted, Harpenden, and at Bridge House, Welwyn, 1·16 in. at Bone Hill, St. Albans, and 1·17 in. at Gorhambury, St. Albans. On the 2nd, that is after 9 a.m., it was at least half an inch at all stations, three quarters of an inch at 21, and an inch at 3 of these: 1·06 in. at Rosebank, Berkhamsted, 1·07 in. at Rose Cottage, Berkhamsted, and 1·10 in. at Cowroast Lock, Tring. On the 8th it reached at least half an inch at one station, and on the 9th at 5 stations. On the 18th at least half an inch at 28 stations, three quarters of an inch at 9 of these, and an inch at 7: 1·03 in. at Gorhambury, St. Albans, 1·05 in. at Bulbourne, Tring, 1·06 in. at Rosebank, Berkhamsted, and at Rose Cottage, Berkhamsted, 1·07 in. at Kensworth, 1·08 in. at Apsley Mills, Hemel Hempstead, and 1·18 in. at Cowroast Lock, Tring. And on the 28th at least half an inch at 18 stations, and three quarters of an inch at one of these, Croxley Green.

* Mean of max. and min., as usually determined.

† Mean of 9 a.m., max., and min., which gives a closer approximation of the mean temperature of the day, and makes the 1st of September the hottest day in the year (at St. Albans), although it had not the highest maximum temperature.

NOVEMBER.—Warm, with an atmosphere of about average humidity, a very cloudy sky, and a heavy rainfall on a considerable number of days. Both day and night temperatures were above the average, and about equally so, giving an average mean daily range. The minimum temperature was below 32° on three or four days only. Scarcely any rain fell after the 20th. The 8th was the wettest day at all stations. On the 4th the rainfall was at least half an inch at 49 stations and three quarters of an inch at 15 of these; on the 6th at least half an inch at 12 stations; and on the 7th at 6 stations and three quarters of an inch at one of these. On the 8th it was at least half an inch at all stations, three quarters of an inch at 52, and an inch at 33 of these. In the *Cam* river-district it was 1·32 in. at Royston and 1·45 in. at Odsey. In the *Ivel*, 1·16 in. at High Down, Hitchin, 1·21 in. at Preston, 1·26 in. at Wratten, Hitchin, 1·28 in. at The Maples, Hitchin, and at The Chilterns, Hitchin, and 1·36 in. at Baldock. In the *Thame*, 1·35 in. at our only station, Bulbourne. In the *Colne*, 1·01 in. at Rosebank, Berkhamsted, 1·03 in. at Bone Hill, St. Albans, and at Frogmore, 1·06 in. at Hill End Asylum, St. Albans, 1·07 in. at Rothamsted, Harpenden, 1·08 in. at Rose Cottage, Berkhamsted, 1·09 in. at Cowroast Lock, Tring, and 1·54 in. at Kensworth, In the *Brent* it did not quite reach an inch. In the *Lea* it was 1·00 in. at the Red House, Ware, 1·01 in. at St. Just, Northaw, 1·04 in. at Much Hadham, 1·06 in. at Gilston Park, and at Broxbourne, 1·08 in. at Danesbury, Welwyn, 1·09 in. at Eileen Cottage, Bennington, and at Hamels Park, 1·10 in. at Hadham Hall and at Hatfield St. Mary's, Newgate Street, 1·13 in. at Throcking Rectory, 1·14 in. at Bridge House, Welwyn, 1·29 in. at Weston Park, 1·30 in. at Barley, and 1·52 in. at Therfield Rectory. Mr. Mawley draws attention to the persistence of this fall, stating that it began at Berkhamsted at 9 p.m. on the 7th and continued without intermission until 4 p.m. on the 9th, or for forty-three consecutive hours.

DECEMBER.—A rather cold month, with an atmosphere of about average humidity, a very cloudy sky, and a rather heavy rainfall on a large number of days. The day temperature was twice as much below the average as that of the night, giving a rather small mean daily range. The temperature was below 32° on about half the number of days in the month. The first four days were very warm, the last seven were very cold. On the coldest night, that of the 26th–27th, the thermometer exposed on the surface of the snow at Berkhamsted registered a temperature only 2° above zero, or 30° of frost, the greatest cold experienced there since the 7th of February, 1895. The first fall of snow of the winter occurred on the 13th. This was the wettest day at 17 stations, the 15th at 14, the 16th at 7, and the 25th at 16. The rainfall reached at least half an inch at one station (Datchworth) on the 13th, at one (Kensworth) on the 16th, and at 6 stations on the 25th, this last fall, however, being in

the form of snow. The fall of snow commenced on this day. At the County Museum, St. Albans, it was 5¼ ins. in depth and yielded 0·45 in. of water; and at Weetwood, Watford, it was 6 ins., and yielded 0·50 in., the yield in each case being one-twelfth the depth of snow, and doubtless this was general over the county. Snow fell at every station on the three following days and on the 30th, and at many also on the 29th. On this day at Berkhamsted its average depth was 8 inches, but at Watford it evaporated or consolidated each day after the 25th to the extent of the fall, never being more than 6 inches in depth. The fall of snow was much the heaviest in the Eastern Counties, reaching 12 inches in depth in Norfolk and Suffolk. In the north-east and south-west of England, the western part of Wales, nearly the whole of Ireland, and much the greater part of Scotland, no snow fell. Accounts of the storm over the British Isles are given by Dr. H. R. Mill in the 'Meteorological Magazine,' vol. xli, pp. 224–226, and in 'British Rainfall,' 1906, the latter more fully and with maps showing the depth of snow over the country and the hour at which it began. The 27th was much the coldest day in the year.

Plate X is from a photograph taken at 2.30 p.m. on the 26th of December. The two rain-gauges seen in the centre foreground are a "Snowdon" on the left (read daily) and a "Howard" on the right (read monthly).

XX.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1906.

By Edward Mawley, F.R. Met. Soc., F.R.H.S., V.M.H.

Read at Watford, 23rd April, 1907.

All parts of the county are well represented with the exception of the north-east portion, which unfortunately still lacks an observer. I regret to announce the retirement of Mr. Henry Lewis, of St. Albans, who for many years past has sent in such interesting returns as to the arrival of birds. Fortunately, another keen bird observer, Mr. W. P. Westell, has kindly taken his place, so that the number of observers and of observing stations remains the same as in the last report.

The following table gives the list of observers, the districts they represent, and the approximate height of the stations above sea-level. Three of the stations are just outside our county boundary, Harefield being in Middlesex, Chesham in Bucks, and Odsey in Cambridgeshire. The sequence is from south to north.

Station.	Height above Sea-level.	Observer.
Harefield (The Scrubbs)	340 feet.	G. E. Eland.
Watford (Weetwood)	270 ,,	Mrs. J. Hopkinson.
Chesham (Cannon Mill Cottage)	300 ,,	Miss G. Keating.
Broxbourne	120 ,,	Rev. H. P. Waller.
St. Albans (New Farm)	400 ,,	Miss A. Dickinson.
St. Albans (Glenferrie Road)	320 ,,	W. P. Westell.
Berkhamsted (Rosebank)	400 ,,	Mrs. E. Mawley.
Hatfield (St. Michael's)	380 ,,	Miss R. Blackett.
Hertford	140 ,,	W. Graveson.
Sawbridgeworth	240 ,,	H. S. Rivers.
Harpenden (Hecla Villa)	370 ,,	J. J. Willis.
Hitchin	230 ,,	A. W. Dawson, M.A.
Odsey, Ashwell	260 ,,	H. G. Fordham.

The Winter of 1905–6.

This was an exceptionally mild and sunny winter. In the last twenty years there have been only three winters in which the mean temperature has been so high, and at no time did the thermometer exposed on the lawn show more than 17 degrees of frost. The total rainfall exceeded the average by only about half an inch, but there was an unusual number of days on which rain fell. The record of clear sunshine at Berkhamsted averaged two hours a day, which is about twenty minutes a day in excess of the mean.

The dry weather in December favoured the cultivation of the land on the farms, but the persistent rains throughout the whole of January and February almost entirely prevented the further preparation of the soil, or the sowing of any spring corn. On the other hand, the continued mild weather greatly assisted the root-crops left in the ground, and enabled the cattle to remain longer in the fields than is usual at this season. The autumn-sown corn, in spite of the wet weather, continued to make steady progress, and at the end of the quarter, notwithstanding the unusual warmth, had not become "winter proud." The frequent rainfall in January and February was welcomed, as it served to replenish the ponds and watering-places, which in many places had become quite dry.

The mild and wet winter favoured the green vegetables in the kitchen-garden, which remained plentiful throughout the season. But, owing to the cold weather in the autumn, there was an unusually small number of flowers to be found in the flower-garden early in the winter.

The earliest plants to flower, such as the winter-aconite, snowdrop, etc., made their appearance unusually early in the year. At Berkhamsted the winter-aconite first showed an open flower on January 7th, which is twelve days earlier than its average date in the same spot for the previous seventeen years, and, with two exceptions, earlier than in any of those years. At Watford the winter-aconite was out on the 4th of January.

Taking the county as a whole, the first flowers appeared on the hazel two days earlier than the average date for the previous thirty years.

The song-thrush was first heard after the beginning of the year, eleven days in advance of its mean date; whereas the honey-bee was first seen to visit flowers eleven days later than usual.

The Spring.

A very changeable season as regards temperature. There occurred two very cold periods, one at the end of March and the other at the end of April and beginning of May, but at no time during the quarter did the exposed thermometer show more than 16 degrees of frost. In all three months the rainfall was deficient, while the record of bright sunshine at Berkhamsted exceeded the average by about twenty minutes a day.

This proved a very trying spring to the farmer, owing to the unworkable condition of the ground throughout nearly the whole season. In March the soil was too cold and wet, and in April too hard and dry. In May, however, the weather was for a time more favourable, but on no occasion was the land in a really good condition for sowing spring corn. Consequently, at the end of the quarter very little progress had in most places been made. The autumn-sown corn, notwithstanding the

frequent frosts at night, still continued to make slow but satisfactory and healthy growth. The pastures, however, remained unusually bare until May, when the nights became warmer, and light falls of rain occurred at rather frequent intervals.

In the garden this was also an unsatisfactory spring. The cold and wet soil in the early part of it caused seeds to germinate slowly and irregularly. There was an abundant show of blossom on the fruit-trees, but the greater part of it was destroyed by the keen frosts in April and May.

Our observer at St. Albans (New Farm) reports that the frost of April 19th turned the almond and cherry blossom brown, while that of April 25th shrivelled and blackened the buds on the horse-chestnut and walnut. At St. Albans (Glenferrie Road) the lilac, although covered with flower-buds, bore no open blossoms. At Hitchin many horse-chestnut buds were destroyed by frost before flowering.

The coltsfoot came into flower three days late, the wood-anemone two days late, the blackthorn one day late, the horse-chestnut six days late, the hawthorn one day late, and the white ox-eye six days late. On the other hand, the garlic hedge-mustard was four days early.

The spring migrants arrived behind their average dates, the swallow being two days late, the cuckoo seven days late, the nightingale ten days late, and the flycatcher two days early.

The wasp made its appearance sixteen days late, the small white butterfly nine days late, and the orange-tip butterfly one day late.

The Summer.

Taken as a whole this was a very warm summer, but only in August was the heat very exceptional. It proved also a very dry season. Indeed, but for a remarkably heavy fall of rain on one day at the end of June, this would have been one of the driest summers ever known. There was a splendid record of sunshine in all three months, while the average duration exceeded the mean for the quarter by as much as one and a half hours a day.

The exceptionally heavy rainfall above referred to was warmly welcomed by the farmers after three weeks of dry weather. This downpour was of great assistance to the grass, but came unfortunately too late to save the hay-crop, which was almost everywhere very poor. The dry weather which followed, however, allowed what hay there was to be harvested very quickly, and in excellent condition. All the other farm-crops were also much benefited for a time by the good soaking the ground had received, but owing to the scanty falls of rain in the next two months little further progress was made, with the exception of the corn, during the rest of the season. The root-crops and pastures were, as usual under such conditions, the greatest sufferers.

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1906, WITH THE MEAN DATES FOR 1876–1905.

SPECIES.	HARE-FIELD.	WAT-FORD.	CHES-HAM.	BROX-BOURNE.	ST. ALBANS.		BERK-HAMSTED.	HAT-FIELD.	HERT-FORD.	SAW-BRIDGE-WORTH.	HAR-PENDEN.	HITCHIN.	MEAN FOR THE 30 YRS.
					GLEN-FERRIE ROAD.	NEW FARM.							
Hazel (*Corylus avellana*)	.....	Jan. 24	Feb. 5	.....	.....	Jan. 17	Feb. 15	Jan. 21	Jan. 28	.....	Jan. 31	Jan. 25	Jan. 29
Coltsfoot (*Tussilago farfara*)	Mar. 4	Mar. 7	Feb. 26	Mar. 18	Mar. 4	Mar. 6	Feb. 16	Mar. 9	Feb. 25	Mar. 6	Mar. 3	Mar. 8	Mar. 1
Wood-Anemone (*Anemone nemorosa*)	Mar. 18	Apl. 1	Mar. 16	Mar. 16	Apl. 1	Mar. 30	Apl. 6	Mar. 21	Mar. 4	Apl. 5	Apl. 5	.....	Mar. 23
Blackthorn (*Prunus spinosa*)	Apl. 10	Apl. 4	Apl. 7	Apl. 15	Apl. 7	Mar. 22	Apl. 11	Mar. 28	Mar. 29	Apl. 13	Apl. 8	Mar. 25	Apl. 4
Garlic Hedge-Mustard (*Alliaria officinalis*)	May 4	Apl. 10	Apl. 26	Apl. 16	Apl. 8	Apl. 6	Apl. 15	.....	Apl. 12	Apl. 25	Apl. 13	Apl. 12	Apl. 20
Horse-Chestnut (*Æsculus hippocastanum*)	May 20	May 9	May 21	.....	May 26	May 7	May 24	May 3	May 13	May 21	May 9	May 12	May 9
Hawthorn (*Cratægus oxyacantha*)	May 14	May 14	May 16	.....	May 13	May 13	May 25	May 2	May 9	May 28	May 13	May 10	May 13
White Ox-Eye (*Leucanthemum vulgare*)	May 31	May 17	May 17	May 10	May 26	.....	May 30	May 30	May 16	June 5	June 8	May 31	May 20
Dog-Rose (*Rosa canina*)	June 12	June 9	.....	June 13	June 23	June 7	June 7	June 8	June 7	.....	June 11	.....	June 6
Black Knapweed (*Centaurea nigra*)	June 27	June 16	.....	.....	.....	.....	July 1	.....	June 24	.....	June 22	.....	June 27
Harebell (*Campanula rotundifolia*)	July 14	June 30	....	.....	.....	June 23	.....	July 10	July 14	.....	.....	.....	July 6
Greater Bindweed (*Convolvulus sepium*)	July 27	July 10	July 20	.....	June 29	.....	July 8	.....	July 13	July 12	.....	.....	July 9
Ivy (*Hedera helix*)	.....	Sept. 14	Sept. 20	.....	.....	Sept. 29	Sept. 30	.....	Sept. 20	Sept. 29	.....	.....	Sept. 27

Hazel: Odsey, Jan. 16.

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1906, WITH THE MEAN DATES FOR 1876–1905.

SPECIES.	HARE-FIELD.	WAT-FORD.	CHES-HAM.	BROX-BOURNE.	ST. ALBANS.		BERK-HAMSTED.	HAT-FIELD.	SAW-BRIDGE-WORTH.	HAR-PENDEN.	HITCHIN.	ODSEY (Ashwell)	MEAN FOR THE 30 YRS.
					GLEN-FERRIE ROAD.	NEW FARM.							
BIRDS.													
Song-Thrush (*Turdus musicus*)	.....	.....	.....	Jan. 15	Jan. 2	Jan. 4	Jan. 7	Jan. 10	Jan. 4	Jan. 7	Jan. 1	.....	Jan. 17
Swallow (*Hirundo rustica*)	Apl. 17	Apl. 6	Apl. 12	Apl. 15	.....	Apl. 23	Apl. 6	Apl. 10	Apl. 14	Apl. 17	Apl. 20	Apl. 17	Apl. 12
Cuckoo (*Cuculus canorus*)	Apl. 17	Apl. 14	Apl. 18	Apl. 11	.....	Apl. 15	Apl. 26	Apl. 15	Apl. 29	Apl. 17	Apl. 26	May 1	Apl. 13
Nightingale (*Daulias luscinia*)	Apl. 16	.....	May 2	May 3	.....	Apl. 21	Apl. 15	Apl. 14	Apl. 23	Apl. 30	Apl. 28	May 12	Apl. 15
Spotted Flycatcher (*Muscicapa grisola*)	.....	.....	.....	May 12	May 26	May 15	.....	May 3	May 9	.....	.....	May 13	May 15 (13 years)
Swallow (last seen) (*Hirundo rustica*)	Sept. 30	Oct. 7	Oct. 15	Oct. 13	.....	Oct. 15	Oct. 23	Oct. 5	Oct. 20	.....	.....	Oct. 13	Oct. 16 (15 years)
INSECTS.													
Honey-Bee (*Apis mellifica*)	.....	Feb. 21	Jan. 27	Feb. 1	.....	Feb. 21	Feb. 21	.....	Jan. 27	Mar. 4	.....	.....	Feb. 2
Wasp (*Vespa vulgaris*)	.....	Apl. 11	Apl. 14	May 10	May 7	.....	Apl. 3	May 2	Apl. 7	May 12	.....	.....	Apl. 7
Small White Butterfly (*Pieris rapæ*)	Apl. 13	Apl. 12	Apl. 10	.....	Apl. 6	Apl. 5	Apl. 7	May 3	Apl. 11	May 8	.....	.....	Apl. 6
Orange-Tip Butterfly (*Anthocaris cardamines*)	.....	May 10	May 8	May 18	May 13	Apl. 27	May 12	.....	May 12	May 13	.....	.....	May 9
Meadow-Brown Butterfly (*Epinephele janira*)	.....	.....	.....	May 18	.....	June 20	.....	.....	.....	.....	.....	.....	May 22

Throughout this dry summer the growth of nearly all plants in the garden was kept in check by the dry weather and great heat, and more particularly owing to the unusual dryness of the air during the greater part of it. Before the end of the summer many trees and shrubs growing on anything like shallow soils had begun to show the effect of the long-continued drought upon them, while the lawns for weeks remained parched up and brown.

Mr. Willis, writing from Harpenden, states that the first wheat-ear was out of its sheath on June 20th, or eight days later than its average date in the previous fourteen years, and that on the 18th of the same month potato haulms were cut down by the frost. At St. Albans (New Farm) turnip and mangold seeds, which were sown in July, took six weeks to germinate. The same observer also reports that the harvest was finished there on August 30th, or within the month. Our observer at Hatfield reports that at the end of the summer the leaves on the lime-trees were turning yellow, and dropping off owing to the drought, while the foliage on some of the beech-trees had become brown and shrivelled. Both at Hatfield and St. Albans wasps are stated to have been unusually numerous.

Taking the plants on the list which flower during the summer months, the dog-rose was five days late, and the greater bind-weed four days late, while the harebell blossomed at its average date, and the black knapweed was three days early.

The Autumn.

With the exception of 1898, this was the warmest autumn in the last twenty years. Each of the three autumn months, and especially October, proved unusually warm. Notwithstanding the dry weather in September, the total rainfall of the season was much in excess of the average. There was a splendid record of sunshine in September, but October and November were, on the other hand, rather dull.

Owing to the great heat in August, a good deal of corn had been got in before the autumn began, and as the same hot and fine weather lasted well into September, the whole of the cereal crops were gathered in with little trouble and in splendid condition. In the middle of the latter month came a wet week, which caused the roots and pastures to improve. But it was October, with its warm nights and days and heavy rainfall, that saved the situation, and enabled the root-crops and pastures, which had become quite bare, for the first time in the year to make any really satisfactory growth. In October ploughing the land for wheat began, and good progress was made, notwithstanding the frequent and heavy falls of rain, for the subsoil had become so dry that it readily absorbed any superfluous moisture on the surface, and therefore soon became workable again. Nothing perhaps showed in so marked a manner the beneficial effect of the change of weather which

took place in October than the vegetables in the kitchen-garden, which had made such poor growth during the summer and early autumn. Except in the case of hard-wooded plants and shrubs the same magical effect on vegetation was to be seen in the flower-garden, which, notwithstanding the frequent and heavy rain, remained unusually gay until the end of the season.

In order to show the persistency of the summer drought, I may state that previous to the middle of September no rain-water at all came through the two and a half feet of soil in my bare soil percolation-gauge for seven weeks.

Timber and other trees, for some reason, which I can only explain by the mildness of the autumn, and the exceptionally heavy rainfall in October and November, retained their leaves unchanged in colour until an unusually late date.

At St. Albans (New Farm) the blackberries are stated to have been unusually fine and plentiful, while there was a fair crop of hazel-nuts. Mr. H. G. Fordham contributes the following interesting notes as to the persistent character of the foliage of the autumn, taking as an illustration the common elm. "November 4th: The common elms remain as green and full of leaf as in June. November 10th: The leaves are changing in colour, but have not begun to fall. November 19th: The trees still retain most of their leaves, which are now yellow. November 25th: Common elms alone now retain their leaves, of which one half remain on sheltered trees. November 29th: The leaves have fallen owing to the wet and wind, and all trees are practically bare."

According to the returns of farm-produce in Hertfordshire in 1906, published by the Board of Agriculture, the yield of wheat was 13 per cent. above the average for the previous ten years, barley 8 per cent. above, beans 15 per cent. above, peas 15 per cent. above, potatoes 11 per cent. above, and mangolds 1 per cent. above, while oats were 1 per cent. below, turnips 2 per cent. below, hay (clover, etc.) 19 per cent. below, and hay (permanent pasture) 77 per cent. below their respective averages for the same ten years.

The fruit-crops, according to the returns sent in to the 'Gardeners' Chronicle,' were as follows. The yield of apples, gooseberries, raspberries, currants, and strawberries was about average, while that of pears and plums proved very scanty.

The last plant on the list, the ivy, taking the county as a whole, came into flower three days in advance of its usual time.

The swallow took its departure four days earlier than its mean date for the previous fifteen years.

In making out the variations from the mean for thirty years of the different plants in the foregoing report, I was struck with the fact that many of those variations differed in a marked degree from the variations of the same plants when the whole of the Midland Counties, instead of Hertfordshire alone, were taken together, and when the mean for the last sixteen years

only was employed to compare the observations with. It may be the seasons in the first half of the last thirty years were, as a rule, earlier than in the last sixteen years of that period, or it may be the discrepancies given below are due in some measure to the different method of observing which has been adopted since I first became phenological recorder to the Society in 1891. It may therefore be of interest if I append here the variations from the mean for the last sixteen years of the different plants in 1906, and compare them with those obtained when the means for the whole thirty years are employed, the variations from the mean for the last sixteen years being placed in each case first. Hazel nine days instead of two days early, coltsfoot one day early instead of three days late, wood-anemone five days early instead of two days late, blackthorn two days early instead of one day late, garlic hedge-mustard three days instead of four days early, hawthorn two days early instead of one day late, white ox-eye one day instead of six days late, dog-rose six days instead of five days late, black knapweed four days instead of three days early, harebell four days early instead of its average date, greater bindweed three days instead of four days late, and ivy two days instead of three days early.

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OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

EDITED BY JOHN HOPKINSON, F.L.S., F.G.S., F.Z.S.,
F. R. Met. Soc., Assoc. Inst. C. E., Sec. Ray Soc.

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THE objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, Ethnology, Pre-Norman Archæology, and Topography of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Physics and Biology. 4. The formation of a Library of works on Natural History. 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

Evening meetings of the Society are held in the rooms of the Watford Urban District Council (Upton House) once a month during the Winter and Spring, and also occasionally at St. Albans and other places. Field meetings are held during the Spring and Summer in various parts of the County.

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XXI.

A PRELIMINARY LIST OF HERTFORDSHIRE DIPTERA.

By A. E. Gibbs, F.L.S., F.E.S., and Philip J. Barraud, F.E.S.

Read at Watford, 23rd April, 1907.

In presenting to the Society the following list of Diptera observed in our County, we wish to express our hearty thanks to the Rev. E. N. Bloomfield, M.A., F.E.S., of Guestling, Hastings, who has given us very great assistance in the identification of specimens, and valuable advice in the preparation of this list; to Mr. E. E. Austen, of the British Museum (Natural History), who has rendered most useful help during the examination of the collections in the Museum; also to the Hon. N. Charles Rothschild, M.A., F.L.S., F.Z.S., who kindly prepared the list of Pulicidæ met with at Tring, and to others who have sent us records of captures.

By far the greater number of records have been obtained from the very extensive collection of flies captured by Mr. Albert Piffard, of Felden, Boxmoor, which is now in the British Museum. This collection was formed during the last decade of the nineteenth century, and contains many thousands of specimens which are carefully labelled with the date and place of capture, and are mostly named by Mr. Piffard. Nearly all the specimens were taken in the immediate vicinity of his home. This mass of material is being gradually incorporated in the new collection of British Diptera at the Museum, each specimen before finding its permanent resting-place in that collection, being examined and its determination verified by Mr. E. E. Austen. For our knowledge of the existence of this collection we are indebted to the Rev. E. N. Bloomfield.

In the following list all the Felden records, except in a few cases where another observer's name is attached, are Mr. Piffard's, and the names of flies taken by him in other localities are followed by his initials (A.P.). The larger number of his specimens are in a cabinet containing the unincorporated accessions, and have not yet been critically examined by Mr. Austen. These are marked in our list with an asterisk (*), and the determination is Mr. Piffard's. When several examples of the same species were found, we have mentioned the date of the earliest capture only. When a species is mentioned as occurring in Hertfordshire by Mr. G. H. Verrall in his book on 'British Flies,' a work in course of publication, we have appended the word 'Verrall' to Mr. Piffard's record. Doubtless these specimens have been examined by Mr. Verrall. A considerable proportion of those

species marked * are not contained in Mr. Verrall's British list, or have only been doubtfully included, and it is probable that when these are examined by specialists many will prove to be known as British species under a different name.

A few records have been extracted from papers in our 'Transactions,' the back volumes of which have been searched for the purpose. In these cases the short title 'Watford Trans.' or 'Herts Trans.' follows the name of the observer. For the records from St. Albans, unless otherwise indicated, Mr. Gibbs (A.E.G.) is responsible; those flies taken in his own garden have the locality given as "Kitchener's Meads."

The Hon. N. C. Rothschild has drawn our attention to the fact that several species of fleas which undoubtedly occur in the County do not appear to have been captured in it, that of the badger and of the common domestic pigeon, for instance, being so far unobserved.

There are doubtless many common species of Diptera to be met with in the County which are as yet unrecorded, and we shall be glad to receive any information which will enable us to extend the present list.

ORTHORRHAPHA.

NEMATOCERA.

Pulicidæ.

The following species of Pulicidæ have been observed by the Hon. N. C. Rothschild at Tring:—

Pulex irritans, *L.*
Ctenocephalus canis, *Curt.*
C. felis, *Bouché.*
C. erinacei, *Bouché.*
Spilopsyllus cuniculi, *Dale.*
Ctenophthalmus sorecis, *Dale.*
C. pentacanthus, *Rothsch.* (also at Felden by Mr. A. Piffard).
C. agyrtes, *Heller.* Sub-sp. nobilis, *Rothsch.* (from water-vole).
C. bisoctodentatus, *Kolen.*
C. dasycnemus, *Rothsch.*
Typhloceras poppei, *Wagner.*
Ctenopsyllus musculi, *Duges.*
C. spectabilis, *Rothsch.*
Hystrichopsylla talpæ, *Curt.*
Ceratophyllus sciurorum, *Bouché.*
C. gallinæ, *Schrank.*
C. hirundinis, *Curt.* (from house-martin).
C. fasciatus, *Bosc.*
C. mustelæ, *Dale.*
C. penicilliger, *Grube.*
C. garei, *Rothsch.*
C. styx, *Rothsch.*
C. Walkeri, *Rothsch.*
C. gallinulæ, *Dale.*
C. fringillæ, *Walker.*
Ischnopsyllus elongatus, *Curt.* (from noctule bat).
I. octactenus, *Kolen.* (jubatus, *Wagner*) (especially from pipistrelle).
I. simplex, *Rothsch.* (? octactenus, *Wagner, nec Kolen.*) (from Natterer's bat).
I. pentactenus, *Kolen.*
I. hexactenus, *Kolen.*

CECIDOMYIDÆ.

Cecidomyinæ.

Cecidomyia destructor, *Say* (Hessian-fly). — Revell's Hall, Hertford, July, 1886, *F. M. Campbell* in 'Herts Trans.'

Diplosis tritici, *Kirby* (wheat-midge).—Knebworth, June, 1881, *Miss E. A. Ormerod* in 'Herts Trans.'; Harpenden, 1881, *J. J. Willis* in 'Herts Trans.'

Hormomyia sp. — * Felden, 10. iv. 97.

Lestreminæ.

Lestremia sp.—*Felden, 18. iii. 97.

MYCETOPHILIDÆ.

Sciarinæ.

Sciara Thomæ, *L.*—Felden, 16. viii. 93.

S. ? quinquelineata, *Mcq.* — *Felden, 15. xi. 96.

S. ? bilineata, *Stæg.*—*Felden, 25. iii. 97.

S. flavipes, *Pz.* — *Felden, 21. xi. 94.

S. annulata, *Mg.*—*Felden, 19. xi. 96.

S. flavimana, *Ztt.*—*Felden (undated).

S. nitidicollis, *Mg.*—*Felden, 22. xi. 93.

Mycetophilinæ.

Cordyla crassicornis, *Mg.* — *Felden, 16. xi. 94.

Dynatosoma nigricoxa, *Ztt.*—*Felden, 26. x. 96.

Mycetophila punctata, *Mg.*—*Felden, 23. x. 96.

M. lineola, *Mg.* — *Felden, 27. x. 96.

M. stolida, *Wlk.* — *Felden, 8. iv. 97.

M. bimaculata, *F.*—*Felden, 3. xi. 96.

M. luctuosa, *Mg.* — *Felden, 30. xi. 94.

M. signata, *Mg.* — Felden, 13. xi. 94.

M. cingulum, *Mg.*—*Felden, 30. x. 94.

M. nebulosa, *Stann.*—*Felden, 1. iii. 99.

M. blanda, *Winn.*—*Felden, 19. xi. 94.

M. spectabilis, *Winn.*—*Felden, 10. vi. 99.

M. unipunctata, *Mg.*—*Felden, 3. i. 99.

M. gratiosa, *Winn.*—*Felden, 9. xi. 96.

M. ? biusta, *Mg.* — *Felden, 1. xii. 94.

M. xanthopyga, *Winn.*—*Felden, 4. xi. 96.

M. marginata, *Winn.*—*Felden, 25. x. 96.

M. flava, *Walk.* — *Felden, 22. x. 99.

Numerous undetermined specimens from Felden.

Trichonta sp.—*Felden, 28. iv. 97.

Rhymosia discoidea, *Mg.* — *Felden, 10. xi. 96.

R. fenestralis, *Mg.*—*Felden, 18. xi. 94.

R. signatipes, *Wulp.*—*Felden. 21. iii. 97.

R. domestica, *Mg.*—*Felden, 29. x. 96.

R. sp. not described by *Winn.*—*Felden, 10. i. 97.

Several undetermined specimens from Felden.

Exechia ?leptura, *Mg.*—*Felden, 26. x. 96.
E. fungorum, *Deg.*—*Felden, 22. xi. 94.
E. lateralis, *Mg.*—*Felden, 10. i. 97.
E. ?tenuicornis, *Wulp.*—*Felden, 25. x. 96.
E. dorsalis, *Stæg.*—*Felden, 17. xi. 94.
E. serrata, *Winn.*—*Felden, 28. iii. 97.
E. sp.—*Felden, 20. iv. 97.
Allodia ornaticollis, *Mg.*—*Felden, 9. iv. 97.
A. crassicornis, *Stan.*—*Felden, 10. iv. 97.
A. obscura, *Winn.*—*Felden, 20. ii. 97.
Other undetermined specimens from Felden.
Mycothera semifusca, *Mg.*—*Felden, 10. i. 97.
M. dimidiata, *Stæg.*—*Felden, 15. iv. 97.
Brachycampta amœna, *Winn.*—*Felden, 18. iv. 97.
B. ?griseicollis, *Stæg.*—*Felden, 21. iv. 97.
Docosia sciarina, *Mg.*—*Felden, 22. ii. 99.
D. valida, *Winn.*—*Felden, 13. iv. 97.
Phronia basalis, *Winn.*—*Felden, 28. x. 96.
P. humeralis, *Winn.*—*Felden, 22. iv. 97.
P. ?forcipula, *Winn.*—*Felden, 17. iv. 97.
P. crassipes, *Winn.*—*Felden, 14. x. 96.
P. nitidiventris, *Wulp.*—*Felden, 21. iv. 97.
P. tenuis, *Winn.*—*Felden, 1. xi. 96.
Sceptonia nigra, *Mg.*—*Felden, 17. x. 94.
Zygomyia valida, *Winn.*—*Felden, 18. xi. 94.
Z. notata, *Stan.*—*Felden, 23. x. 96.
Z. pictipennis, *Stæg.*—*Felden, 20. xi. 94.
Z. vara, *Stæg.*—*Felden, 21. xi. 94.
Cœlosia sp.—*Felden, 9. iii. 99.
Glaphyroptera fascipennis, *Mg.*—*Felden, 27. v. 97.
G. ?graminis.—*Felden, 8. x. 01.
G. ?fasciola, *Mg.*—*Felden, 23. x. 96.
G. bimaculata, *Mg.*—*Felden, 3. x. 97.
Other unnamed specimens from Felden.
Boletina dubia, *Stæg.*—*Felden, 14. iv. 97.
B. sciarina, *Stæg.*—*Felden, 16. x. 96.
B. nigricoxa, *Stæg.*—*Felden, 20. xi. 98.
Leptomorphus Walkeri, *Curt.*—Felden, 1. x. 94.

Sciophilinæ.

Lasiosoma hirtum, *Mg.*—*Felden, 21. iv. 97.
Sciophila fasciata, *Ztt.*—*Felden, 4. x. 94.
S. cinerascens, *Mcq.*—*Felden, 7. xi. 94.
S. punctata, *Mg.*—*Felden, 20. iv. 97.
S. incisurata, *Ztt.*—*Felden, 26. x. 96.
S. lucorum, *Winn.*—*Felden, 10. v. 97.
S. limbata, *Winn.*—*Felden, 1. xii. 94.
S. inanis, *Winn.*—*Felden, 14. xi. 94.
S. dorsata.—*Felden, 1. vi. 99.
S. spp.—*Felden, 19. x. 97. and 29. x. 97.

Ceroplatinæ.

Platyura nemoralis, *Mg.*—*Felden, 10. vi. 99.

P. ?infuscata, *Winn.*—Felden, 12. vi. 95.

P. sp.—*Felden, 27. v. 97.

Macrocerinæ.

Macrocera fasciata, *Mg.*—*Felden, 28. viii. 99.

M. centralis, *Mg.*—Felden, 9. vi. 93.

M. stigma, *Curt.*—Felden, 27. v. 97.

M. phalerata, *Mg.*—Felden, 3. vi. 98.

M. maculata, *Mg.*—Felden, 18. ix. 97.

M. sp. (with hairy wings).—*Felden, 5. vi. 95.

Mycetobinæ.

Ditomyia fasciata, *Mg.*—*Felden, 2. viii. 99.

Bolitophilinæ.

Bolitophila fusca, *Mg.*—*Felden, 1. xi. 96.

B. cinerea, *Mg.*—*Felden, 25. x. 96.

B. cinerascens.—*Felden, 29. x. 94.

BIBIONIDÆ.

Scatopse notata, *L.*—*Felden, 19. xi. 96.

S. scutellata, *Lw.*—Felden, 21. x. 92.

S. flavicollis, *Mg.*—Bovingdon, *A.P.*, 20. x. 92.

Dilophus febrilis, *L.* (vulgaris, *Mg.*), (fever fly).—Aldbury, *A.E.G.*, 30. viii. 04; *Felden, 10. ii. 97; Kitchener's Meads, v. 04.

D. ?albipennis, *Mg.*—*Felden, 2. iii. 97.

D. humeralis, *Ztt.*—Felden, 5. iii. 93.

Bibio pomonæ, *F.*—Berkhamsted, *W. R. O. Grant*, 30. vi. 95; *Felden, 22. vii. 01.

B. Marci, *L.* (St. Mark's fly).—Tring, *E. E. Austen*, 26. v. 92; Felden, 29. iv. 93; Hemel Hempstead, *G. E. Bullen*; Kitchener's Meads, v. 04; Bricket Wood, *A.E.G.*; Watford, *J. Hopkinson* and *F. W. Silvester* in 'Herts Trans.', 25. iv. 80, etc.; Harpenden, *F. W. Silvester* and *J. J. Willis* in 'Herts Trans.', 1. vii. 83, etc.; Hitchin, *W. Hill* in 'Herts Trans.', 18. iv. 83, etc.

B. leucopterus, *Mg.*—Felden, 5. v. 93.

B. venosus, *Mg.*—Felden, 7. v. 94.

B. laniger, *Mg.*—*Felden, 16. v. 97.

B. clavipes, *Mg.*—Felden, 10. x. 92; *Tring, *A.P.*, 3. v. 97.

SIMULIDÆ.

Simulium ornatum, *Mg.*, var. fasciatum, *Mg.*—Felden, 8. iii. 93; Bricket Wood, *A.P.*, 13. iii. 93.

S. reptans, *L.*—Felden, 6. iv. 93; var. fasciatum, *Rnd.*—Felden, 7. v. 97.

S. lineatum, *Mg.* (maculatum, *Mg.*).—Felden, 9. iii. 93; Bricket Wood, *A.P.*, 13. iii. 93.

Chironomidæ.

Chironomus riparius, *Mg.*—*Felden, 30. iii. 97.
C. rufipes, *L.*—*Felden, 5. viii. 99.
C. pedellus, *Deg.*—Felden, 28. iv. 93.
Orthocladius sordidellus, *Ztt.*—Felden, 8. iv. 93.
Metriocnemus fuscipes, *Mg.*—Felden, 10. iii. 93.
Tanypus varius, *F.*—Felden, 28. iii. 93.
T. nebulosus, *Mg.*—Felden, 29. iii. 93.
T. ?carneus, *F.*—Felden, 30. iii. 93.
Ceratopogon bipunctatus, *L.*—Felden, 30. iv. 93.
C. ?minutus, *Mg.*—*Felden, 10. xi. 96.
C. varius, *Winn.*—*Felden, 6. iii. 93.
C. sp. (group of venustus, *Mg.*)—*Felden, 24. iii. 97.
Numerous unnamed species from Felden and St. Albans.

Culicidæ.

Theobaldia annulata (Culex annulatus, *Schrk.*).—Felden, 5. iii. 93; St. Albans, *A. Tremayne Buller*, 15. xi. 07.
Culex ornatus, *Mg.*—*Felden, 26. vii. 99.
C. pipiens, *L.* (common gnat).—Kitchener's Meads, viii. 04.
C. ?cantans, *Mg.*—Kitchener's Meads, v. 04.

Ptychopteridæ.

Ptychoptera contaminata, *L.*—St. Albans, v. 04.
P. sp.—*Felden, 23. ix. 98.

Limnobidæ.

Limnobinæ.

Limnobia bifasciata, *Schrk.* (xanthoptera, *Mg.*).—*Felden, 14. x. 94; Bricket Wood, *A.E.G.*, 29. viii. 04.
L. quadrinotata, *Mg.*—*Felden, 17. viii. 94; St. Albans, 03.
L. nubeculosa, *Mg.*—Felden, 23. x. 96; St. Albans, vi. 04; Gorhambury, *A.E.G.*, 20. v. 05.
L. flavipes, *F.*—*Felden, 24. vi. 96; St. Albans, vi. 04.
L. nigropunctata, *Schum.*—St. Albans, v. 04.
L. tripunctata, *F.*—*Felden, 6. vi. 99; St. Albans, v. 04.
Dicranomyia chorea, *Wied.*—*Felden, 8. iv. 93.
D. sericata, *Mg.*—St. Albans.
D. sp.—*Felden, 16. v. 99.

Eriopterinæ.

Rhypholophus lineatus, *Mg.* (labelled *Dasyptera? lineola*).—*Felden, 15. iv. 93.
Dasyptera nodulosa, *Mcq.*—*Felden, 6. ix. 96 (marked "?").
D. (Rhypholophus) hæmorrhoidalis, *Ztt.*—*Felden, 13. x. 98.
Erioptera trivialis, *Mg.*—*Felden, 23. x. 98.
Symplecta punctipennis, *Mg.*—Felden, 26. iii. 93.
S. similis, *Schum.*—Felden, 1. iv. 93.
Gnophomyia (Trimicra) pilipes, *F.*—*Felden, 9. x. 98.

Limnophilinæ.

Pœcilostola pictipennis, *Mg.*—*Felden, 27. ix. 96.
Limnophila sp.—*Felden, 29. iii. 97.
Trichocera annulata, *Mg.*—Felden, 21. x. 96.
T. hiemalis, *Deg.* (winter gnat).—Abundant everywhere.
T. regelationis, *L.*—Felden, 22. x. 96.
T. sp.—*Felden, 17. iii. 97.

Amalopinæ.

Ula pilosa, *Schum.*—Felden, 22. x. 96.
Dicranota bimaculata, *Schum.*—Felden, 8. iii. 93.
D. sp.—*Felden, 21. v. 99.

TIPULIDÆ.

Pachyrrhina imperialis, *Mg.*—*Felden(marked?),19.vii.96; Kitchener's Meads, viii. 05.
P. histrio, *F.* — Kitchener's Meads.
P. ?maculosa, *Mg.*—St. Albans, vi. 04.
P. quadrifaria, *Mg.*—Kitchener's Meads, vi. 04.
Tipula pagana, *Mg.*—Felden, 10. x. 94; Kitchener's Meads, x. 04.
T. rufina, *Mg.*—*Felden, 18. ix. 96.
T. hortensis, *Mg.*—Kitchener's Meads; Watford, *A.E.G.*, 20. ix. 04.
T. varipennis, *Mg.*—*Felden, 11. v. 93; St. Albans, 3. vi. 05.
T. scripta, *Mg.*—*Felden, 18. vi. 93.
T. flavolineata, *Mg.*—*Felden, 5. v. 93.
T. lateralis, *Mg.*—*Felden, 1. iv. 93; ? St. Albans, vi. 04.
T. gigantea, *Schrk.*—The Grove, Watford, *A.E.G.*, 20. ix. 04; St. Albans, 10. vi. 04.
T. oleracea, *L.*—Common everywhere.
T. ochracea, *Mg.*—*Felden, 17. v. 93; St. Albans, vi. 04.
Dictenidia bimaculata, *L.*—Felden, 4. vi. 94.
Ctenophora pectinicornis, *L.*—Felden, 11. v. 93.

RHYPHIDÆ.

Rhyphus punctatus, *F.*—St. Albans, vi. 04.

BRACHYCERA.

STRATIOMYIDÆ.

Clitellarinæ.

Nemotelus pantherinus, *L.*—Felden, 20. vi. 99.
N. nigrinus, *Fln.*—Felden, 30. vi. 99.
Oxycera pulchella, *Mg.*—*Gadesbridge, 10. v. 01.

Stratiomyinæ.

Stratiomys potamida, *Mg.*—Felden, 5. viii. 97.
Odontomyia viridula, *F.*—Felden, 30. vi. 99; Broxbourne, *Jennings.*

Sarginæ.

Chrysonotus bipunctatus, *Scop.*—Felden, 30. viii. 93.
Sargus flavipes, *Mg.*—Felden, 30. viii. 93.
S. cuprarius, *L.*—Cheshunt, *Jennings.*
S. iridatus, *Scop.* (infuscatus, *Mg.*).—St. Albans, vi. 04.
Chloromyia formosa, *Scop.*—Tring, *Grant*, 21. vi. 96; Berkhamsted, *Grant*, 30. vi. 95; St. Albans, vi. 04; Broxbourne, *Jennings.*
Michrochrysa polita, *L.*—Tring, *Grant*, 21. vi. 96; Felden, 29. iv. 93; Kitchener's Meads, 22. vi. 04; Bushey Heath, bred 1904, *Barraud.*

Berinæ.

Beris clavipes, *L.*—Felden, 22. v. 98.
B. vallata, *Forst.*—Felden, 3. vii. 94.
B. chalybeata, *Forst.*—Felden, 27. v. 98.
Chorisops tibialis, *Mg.*—Felden, 10. vii. 94.

TABANIDÆ.

Hæmatopota pluvialis, *L.* (horse fly).—St. Albans, *Miss A. Dickinson*; Broxbourne, *Jennings.*
H. crassicornis, *Whlbg.*—Cheshunt, *Jennings.*
Therioplectes tropicus, *Mg.*—Felden, 15. vi. 96.
Tabanus sudeticus, *Zlr.* (bovinus, *L.*).—Felden, 7. vii. 93.
T. autumnalis, *L.* (gad-fly).—Felden, 17. vii. 99; Bushey Heath, *Barraud*, vii. 01.
Chrysops cæcutiens, *L.*—Aldbury Down, Tring, *Furnival*; Felden, 24. vii. 93; New Farm, St. Albans, *Miss A. Dickinson*; Kitchener's Meads, viii. 04.

LEPTIDÆ.

Leptis scolopacea, *L.*—Kitchener's Meads; Broxbourne, *Jennings.*
L. tringaria, *L.*—Felden, 4. viii. 93; Broxbourne, *Jennings.*
Chrysopilus auratus, *F.*—Kitchener's Meads, 22. vi. 04.
Symphoromyia immaculata, *F.*—Felden, 18. vi. 93.

ASILIDÆ.

Dasypogoninæ.

Leptogaster cylindrica, *Deg.*—Felden, 5. v. 93.
Dioctria œlandica, *L.*—Felden, 3. v. 93; Broxbourne, *Jennings.*
D. rufipes, *Deg.*—Berkhamsted, *Grant*, 30. vi. 95; Felden, 7. v. 93; St. Albans, 5. vi. 04.
D. linearis, *F.*—Berkhamsted, *A.P.*, 30. vi. 95; Felden, 18. vii. 94.
Isopogon brevirostris, *Mg.*—Tring, *A.P.*, 15. vi. 97; Felden, 15. vi. 97.

Laphrinæ.

Laphria marginata, *L.*—Felden, 16. viii. 98.

Asilinæ.

Machimus atricapillus, *Fln.*—Aldbury Down, *Barraud*, 29. viii. 03, *A.E.G.*, 12. viii. 05; St. Albans.

BOMBYLIDÆ.

Bombylius major, *L.* (great bee-fly).—Aldbury, *A.E.G.*, v. 89; Hemel Hempstead, *Bullen*; Felden, 22. iii. 93; New Farm, St. Albans, *Miss A. Dickinson*; Pré Wood, St. Albans, *A.E.G.*, 5. vi. 04, *Barraud*, 22. iv. 06; Kitchener's Meads.

THEREVIDÆ.

Thereva nobilitata, *F.*—Boxmoor, *A.P.*, 16. vi. 92.
T. fulva, *Mg.*—*Felden, 7. vii. 96.
T. ? plebeia, *L.*—*Felden, 5. v. 99.
T. bipunctata, *Mg.*—Boxmoor, *A.P.*, undated; *Felden, 8. vii. 96.
T. arcuata, *Lw.*—*Felden, 9. vi. 99.

CYRTIDÆ.

Acrocera globulus, *Pz.*—*Felden, 15. vii. 01.

EMPIDÆ.

Hybotinæ.

Hybos grossipes, *L.*—*Felden, 6. viii. 99.
H. femoratus, *Müll.*—Felden, 5. vii. 99; St. Albans, viii. 04.
H. culiciformis, *F.*—*Felden, 31. viii. 98.
Cyrtoma nigra, *Mg.*—*Felden, 30. v. 99.
C. spuria, *Fln.*—*Felden, 26. v. 99.

Empinæ.

Rhamphomyia ? cinerascens, *Mg.*—*Felden, 2. v. 93.
R. flava, *Fln.*—*Felden, 29. vii. 99.
R. tenuirostis, *Fln.*—*Felden, 10. viii. 98.
Empis tessellata, *F.*—Pré Wood, *A.E.G.*, 25. vi. 04.
E. livida, *L.*—Felden, 5. v. 93; Bushey Heath, *Barraud*, 16. vi. 06.
E. opaca, *F.*—Felden, 29. v. 99; St. Albans, v. 04.
E. stercorea, *L.*—Gorhambury, *A.E.G.*, 20. v. 05; St. Albans, 13. v. 04.
E. trigramma, *Mg.*—*Felden, 25. iv. 93; Kitchener's Meads, v. 04.
E. lutea, *Mg.*—*Felden, 23. vi. 93.
E. pennaria, *Fln.*—*Felden, 20. iv. 97.
E. chioptera, *Fln.*—*Felden, 18. iv. 93.
E. funebris, *Mg.*—*Felden, 2. v. 97.
E. florisomna, *Lw.*—*Felden, 25. iv. 93.
E. pteropoda, *Egg.*—*Felden, 4. viii. 99.
E. discolor, *Lw.*—*Felden, 17. vii. 99.
Pachymeria femorata, *F.*—*Felden, 30. v. 99; St. Albans, v. 04.
Hilara pilosa, *Ztt.*—*Felden, 15. v. 97.
H. quadrivittata, *Mg.*—*Felden, 10. vi. 99.
H. chorica, *Fln.*—*Felden, 21. vii. 99.

Ocydrominæ.

Microphorus ? velutinus, *Mcq.* —*Felden, 19. v. 99.
Ocydromia glabricula, *Fln.*—*Felden, 22. v. 99.
Ardoptera irrorata, *Fln.*—*Felden, 1. x. 98.

Tachydrominæ.

Drapetis assimilis, *Fln.*—*Felden, 19. iii. 97.
Tachydromia nervosa, *Mg.* (Tachypeza nubila, *Mg.*).—*Felden, 1. xi. 94.
Tachydromia agilis, *Mg.*—Felden, 20. v. 99.
T. cimicoides, *F.* — *Felden, 15. iv. 93.
T. (Platypalpus) exigua, *Schin.* —*Felden, 27. v. 99.

DOLICHOPODIDÆ.

Psilopus platypterus, *F.*—Felden, 2. vii. 99.
Dolichopus atratus, *Mg.*—Felden, 14. vii. 99.
D. campestris, *Mg.*—Felden, 30. vi. 99.
D. plumipes, *Scop.*—Felden, 7. vii. 99.
D. griseipennis, *Stan.*—Felden, 1. vii. 99.
D. festivus, *Hal.*—Felden, 14. vii. 99.
D. trivialis, *Hal.*—Felden, 1. vii. 99.
D. æneus, *Deg.* (ungulatus, *L.*). —Felden, 8. vii. 99.
Several undetermined species from St. Albans.
Pœcilobothrus nobilitatus, *L.* —Felden, 6. vii. 99.
Hercostomus (Gymnopternus) ? convergens, *Lw.*—*Felden, 26. vii. 99.
Hypophyllus ? obscurellus, *Fln.* —*Felden, 30. vii. 99.
Orthochile unicolor, *Lw.*—*Felden, 10. vii. 99.
Gymnopternus ? ærosus, *Fln.* —*Felden, 11. vii. 99.
G. sp.—*Felden, 3. x. 98.
Chrysotus neglectus, *W.*—*Felden, 13. vii. 99.
C. læsus, *W.*—*Felden, 24. vii. 99.
C. gramineus, *Fln.*—*Felden, 13. vii. 99.
Diaphorus nigricans, *Mg.*—*Felden, 14. vii. 99.
D. oculatus, *Fln.*—*Felden, 14. vii. 99.
Argyra diaphana, *F.*—Felden, 16. v. 94.
A. confinis, *Ztt.*—*Felden, 14. vii. 99.
Porphyrops spinicoxus, *Lw.*—*Felden, 2. vii. 93.
P. fascipes, *Mg.*—Felden, 17. vii. 99.
P. ? micans, *Mg.*—*Felden, 12. vii. 99.
P. elegantulus, *Mg.*—Felden, 14. viii. 99.
P. ? sp.—*Bricket Wood, *A.P.*, 23. iii. 93.
Medeterus truncorum, *Mg.*—*Felden, 26. ix. 94.
M. sp.—*Felden, 12. v. 99.
Scellus notatus, *F.*—Felden, *A.P.*, 13. v. 93, and *E. E. Austen*, 8. vii. 94.
Hydrophorus bipunctatus, *Lehm.*—Felden, 27. ix. 98.
H. spp.—*Felden, 15. iii. 93 and 20. xi. 96; *Bricket Wood, *A.P.*, 15. iii. 93.
Campsicnemus curvipes, *Fln.* —*Felden, 29. ix. 98; *Bricket Wood, *A.P.*, 13. iii. 93.

There are many unnamed species belonging to the preceding Family in the unarranged collection, chiefly from Felden, presented by Mr. Piffard.

LONCHOPTERIDÆ.

Lonchoptera lutea, *Ps.*—*Felden, 22. x. 92.
L. flavicauda, *Mg.*—*Felden, 24. x. 92.
L. lacustris, *Mg.*—*Felden, 23. x. 92.
L. trilineata, *Ztt.*—*Felden, 23. x. 94.
L. tristis, *Mg.*—*Felden, 30. xi. 98.

CYCLORRHAPHA.

PROBOSCIDEA.

PLATYPEZIDÆ.

Platypeza consobrina, *Ztt.*—*Felden, 22. viii. 93. 'Verrall.'
P. modesta, *Ztt.*—*Felden, 21. ix. 97. 'Verrall.'
P. rufa, *Mg.*—*Felden, 21. ix. 97.
P. dorsalis, *Mg.* (subfasciata, *Mg.*).—*Felden, 16. ix. 97. 'Verrall.'
P. fasciata, *Mg.*—*Felden, 1. ix. 97. 'Verrall.'
P. hirticeps, *Verr.*—Felden, 10. x. 97, in 'Verrall,' p. 53. "These two females had been confounded with *P. fasciata*, from which they are quite distinct."—Verrall.
P. infumata, *Hal.*—*Felden, 30. vi. 98.
P. picta, *Mg.*—*Felden, 3. x. 97. 'Verrall.'

PIPUNCULIDÆ.

Chalarus spurius, *Fln.*—*Felden, 10. vii. 01.
Verrallia pilosa, *Ztt.*—*Felden, 9. vii. 01.
Pipunculus auctus, *Fln.*—*Felden, 22. vi. 99.
Pipunculus zonatus, *Ztt.*—*Felden, 29. vii. 01.
P. modestus, *Hal.*—*Felden, 6. vii. 01. 'Verrall.'
P. fuscipes, *Ztt.*—*Felden, 3. viii. 01.
P. ruralis, *Mg.*—*Felden, 25. viii. 97.
P. unicolor, *Ztt.*—*Felden, 30. vii. 01.
P. terminalis, *Thoms.*—*Felden, 6. ix. 01.
P. halteratus, *Mg.*—*Felden, 7. vii. 01.
P. campestris, *Ltr.*—*Felden, 29. viii. 99.
P. nigritulus, *Ztt.* (geniculatus, *Mg.*).—*Felden, 29. vii. 99.
P. ater, *Mg.*—*Felden, 28. viii. 99.
P. nigritus.—*Felden, 14. ix. 99.

SYRPHIDÆ.

Syrphinæ.

Pipizella virens, *F.*—Tring, *Furnival*, 16. vii. 05; Boxmoor, *A.P.*
P. flavitarsis, *Mg.*—*Felden, 20. vi. 01.
P. annulata, *Mcq.* (virens, *F.*).—*Felden, 16. vii. 99.
Pipiza noctiluca, *L.*—*Felden, 24. v. 93; St. Albans, vi. 04; Barnet, *Furnival*, 29. v. 04.

P. bimaculata, *Mg.*—Barnet, *Furnival*, 29. v. 04.

Specimens labelled *P.* '*carbonaria*,' 14. v. 93, and *P.* '*funebris*,' 7. viii. 93, from Felden, are among the unarranged specimens at South Kensington.

Cnemodon vitripennis, *Mg.*—*Felden, 13. iv. 01.

Liogaster metallina, *F.* (violacea, *Mg.*).—*Felden, 26. vii. 99.

Chilosia sparsa, *Lw.*—Felden, 7. v. 93.

C. antiqua, *Mg.*—*Felden, 11. v. 93.

C. scutellata, *Fln.*—*Felden, 22. v. 93.

C. soror, *Ztt.*—*Felden, 15. ix. 01.

C. pulchripes, *Lw.*—Felden, 18. iv. 93; St. Albans, v. 04.

C. variabilis, *Pz.*—Aldbury Down, *Furnival*, *Barraud*, 25. vii. 03; Kitchener's Meads, v. 04.

C. honesta, *Rnd.* (lasiopa, *Kow.*).—Felden, 24. iv. 93. 'Verrall.'

C. illustrata, *Harr.*—Aldbury Down, *Furnival*, 16. vii. 05.

C. grossa, *Fln.*—Felden, 23. iii. 97.

C. albipila, *Mg.* (flavicornis, *Auct.*).—Felden, 5. iv. 99.

C. impressa, *Lw.*—*Felden, 17. vii. 93.

C. albitarsis, *Mg.*—Felden, 25. iv. 93.

C. proxima, *Ztt.*—*Felden, 25. vii. 01.

C. melanopa, *Ztt.*—*Felden, 24. iii. 97.

C. fasciata, *Schin.* & *Egg.*—*Felden, 26. iv. 97.

C. ?mutabilis, *Fln.*—*Felden, 11. v. 93.

C. ?præcox, *Ztt.*—*Felden, 21. iv. 99.

C. ?chloris, *Mg.*—*Felden, 10. v. 93.

C. ?decidua, *Egg.*—*Felden, 7. vi. 93.

Platychirus manicatus, *Mg.*—Aldbury Down, *Furnival*; Kitchener's Meads.

P. peltatus, *Mg.*—Kitchener's Meads, 27. viii. 04.

P. albimanus, *F.*—Felden, *E. E. Austen*, 5. vi. 98; Kitchener's Meads, v. 04.

P. clypeatus, *Mg.*—Aldbury, *A.E.G.*, 30. viii. 04; Kitchener's Meads.

Pyrophæna granditarsa, *Forst.* (ocymi, F.).—Felden, 5. v. 93.

Melanostoma ambiguum, *Fln.*—Felden, 30. v. 93.

M. scalare, *F.*—St. Albans, v. 04.

Melangyna quadrimaculata, *Verr.*—Felden, 11. iii. 93; Bricket Wood, *A.P.*, 21. iii. 93. 'Verrall.'

Leucozona lucorum, *L.*—Broxbourne, *Jennings*; New Barnet, *Furnival*.

Catabomba pyrastri, *L.*—Aldbury Down, *Furnival*, 29. viii. 03; Felden, 23. vi. 93; Welwyn, *Grant*, 30. vii. 93.

Syrphus albostriatus, *Fln.*—Felden, 23. v. 93.

S. tricinctus, *Fln.*—Felden, 16. v. 99.

S. venustus, *Mg.*—Felden, 7. v. 93; Kitchener's Meads.

S. annulatus, *Ztt.*—Felden, 12. viii. 93.

S. ribesii, *L.*—Pré Wood, *A.E.G.*, vi. 04; St. Albans, v. 04; *Barraud*, 13. v. 06.

S. vitripennis, *Mg.*—Felden, 8. viii. 93; Kitchener's Meads.

S. latifasciatus, *Mcq.*—Aldbury, *Furnival*, 13. viii. 05; Felden, 19. iv. 93.

S. corollæ, *F.*—St. Albans.

S. luniger, *Mg.*—Tring, *Furnival*, 13. viii. 05; Felden, 24. v. 93; St. Albans, 01.
S. bifasciatus, *F.* — Felden, *E. E. Austen*, 7. v. 93; Kitchener's Meads, v. 04; St. Albans, *Barraud*, 13. v. 06.
S. balteatus, *Deg.* — Aldbury, *A.E.G.*, 30. viii. 04; Kitchener's Meads.
S. cinctellus, *Ztt.*—Felden, 28. vii. 93.
S. cinctus, *Fln.*—Felden, 7. v. 93.
S. auricollis, *Mg.*—Aldbury, *A.E.G.*, 30. viii. 04.
S. euchromus, *Kow.*—Felden, 12. v. 93.
S. guttatus, *Fln.*—Felden, 12. vi. 93. 'Verrall.'
S. compositarum, *Verr.*—Felden, 21. vi. 93.
Sphærophoria scripta, *L.*—St. Albans, v. 03; var. dispar, *Lw.*—Felden, 7. viii. 93.
S. flavicauda, *Ztt.*, var. nitidicollis, *Ztt.*—Felden, 4. ix. 93.
Xanthogramma ornatum, *Mg.*—Kitchener's Meads, v. 05.
X. citrofasciatum, *Deg.*—Felden, 9. v. 93.
Baccha elongata, *F.*—Felden, 5. v. 93; St. Albans, viii. 04.
Ascia podagrica, *F.*—St. Albans, v. 04.
Brachyopa bicolor, *Fln.*—Felden, 15. v. 94.
Rhingia campestris, *Mg.*—St. Albans, v. 04; Cheshunt, *Jennings*.

Volucellinæ.

Volucella bombylans, *L.*—Aldbury, *Furnival*, 16. vii. 05; *Barraud*, 17. vi. 06.
V. inflata, *F.*—Felden, 28. v. 93.
V. pellucens, *L.* — Aldbury, *Furnival*, 25. vii. 03; Berkhamsted, *Grant*, 30. vi. 95; Kitchener's Meads; Eastbury, *W. Wesché*.

Eristalinæ.

Eristalis æneus, *Scop.*—Welwyn, *Grant*, 28. viii. 01.
E. tenax, *L.* (drone fly). — Common everywhere.
E. intricarius, *L.*—Tring, *N. C. Rothschild*, 24. vii. 98; Aldbury, *Barraud*, 5. viii. 05; Boxmoor, *A.P.* (undated); Kitchener's Meads, v. 04; New Barnet, *Furnival*, 27. vii. 01.
E. arbustorum, *L.*—Aldbury, *A.E.G.*, 30. viii. 05; St. Albans, 25. xii. 02, *Barraud*, 12. v. 07.
E. pertinax, *Scop.*—Kitchener's Meads, 13. v. 04; St. Albans, *Barraud*, 13. v. 06.
E. horticola, *Deg.*—St. Albans, *Barraud*, 13. v. 06.
Myiatropa florea, *L.*—Aldbury, *Furnival*; New Farm, St. Albans, *Miss A. Dickinson*; St. Albans.
Helophilus hybridus, *Lw.* — Aldbury, *Furnival*, 29. viii. 03; Barnet, *Furnival*, 29. v. 04.
H. pendulus, *L.* — Aldbury, *A.E.G.*, ix. 04; Kitchener's Meads, 27. viii. 04.
H. transfugus, *L.*—Cheshunt, *Jennings*. (One on leaf of *Alisma plantago* in ditch, 12. viii. 06.)
H. lineatus, *F.*—* Felden, 10. vi. 99.

Milesinæ.

Criorrhina berberina, *F.*—Felden, 16. v. 93; Boxmoor, *A.P.* 'Verrall.'
C. oxyacanthæ, *Mg.*—Felden, 16. v. 93.
C. floccosa, *Mg.*—Felden, 7. v. 94.
Xylota segnis, *L.*—Felden, 4. vi. 93; Pré Wood, *A.E.G.*, 23. vi. 04; Barnet, *Furnival*, 29. v. 04.
X. lenta, *Mg.*—Felden, 24. v. 93.
X. sylvarum, *L.*—Berkhamsted, *W. R. O. Grant*, 30. vi. 95.
Syritta pipiens, *L.*—St. Albans, v. 04.
Eumerus ornatus, *Mg.*—Felden, 4. vi. 94.
Chrysochlamys cuprea, *Scop.*—Felden, 20. iv. 93, 'Verrall'; Pré Wood, *A.E.G.*, vi. 04.

Chrysotoxinæ.

Chrysotoxum cautum, *Harr.* (sylvarum, *Mg.*).—Berkhamsted, *Grant*, 30. vi. 95; St. Albans, 10. v. 06.
C. octomaculatum, *Curt.*—Welwyn, *Grant*, 30. vii. 93.
C. festivum, *L.*—Felden, 23. vi. 93; Aldbury, *Furnival*, 25. vii. 03; Berkhamsted, *Grant*, 30. vi. 95.
C. bicinctum, *L.*—Felden, 4. vi. 93; Aldbury, *Furnival*, 25. vii. 03.
Callicera ænea, *F.*—Berkhamsted, 1888, 'Verrall.'

CONOPIDÆ.

Conopinæ.

Conops quadrifasciata, *Deg.*—Aldbury, *A.E.G.*, 30. viii. 04; Felden, 1. viii. 93.
C. flavipes, *L.*—Aldbury, *A.E.G.*, 30. viii. 04; Felden, 17. viii. 93.
Physocephala rufipes, *F.*—Aldbury, *Furnival*, 16. vii. 05.

Myopinæ.

Zodion cinereum, *F.*—Felden, 15. v. 93.
Z. notatum, *Mg.*—*Felden, 12. vi. 93.
Oncomyia atra, *F.*—*Felden, 25. viii. 97.
O. pusilla, *Mg.*—*Felden, 10. vii. 99.
Sicus ferrugineus, *L.*—Tring, *N. C. Rothschild*, 24. vii. 98; *Furnival*, 29. viii. 03.
Myopa buccata, *L.*—Felden, 7. v. 93.
M. testacea, *L.*—Felden, 20. v. 93; Cheshunt, *Jennings*.
M. fasciata, *Mg.*—*Felden, 27. vii. 96.

ŒSTRIDÆ.

Gastrophilus equi, *F.* (horse bot-fly).—Aldbury, *A.E.G.*, 30. viii. 04; Felden, 22. vii. 99.
Œstrus ovis, *L.*—Tring, *Grant*, 25. vii. 97.

TACHINIDÆ.

Tachininæ.

Meigenia bisignata, *Mg.*—Felden, 8. viii. 93; var. vernalis, *Desv.*, Felden, 8. viii. 93.
M. floralis, *Mg.*—Felden, 29. vi. 93.
M. majuscula, *Meade* (? Hyria tibialis, *Fln.*).—*Felden, 4. v. 96.
M. sp.—*Felden, 93.
Viviana cinerea, *Fln.*—Felden, 17. vii. 93; *Tring, *A.P.*, 13. vi. 96.
Ceromasia (Masicera) juvenilis, *Rnd.*—*Herts, *A.P.*, 17. vii. 96.—"Felden" struck out on label.
C. senilis, *Mg.* (myiodea, *Dsv.*).—Felden, 21. vi. 94.
C. stabulans, *Mg.*—Felden, 22. v. 93.
C. spectabilis, *Mg.* (probably C. Wulpii, *Br. & v. Berg.*).—Felden, 22. v. 94.
Gymnochæta viridis, *Fln.*—Tring, *A.P.*, 26. iv. 97; Felden, 10. v. 97.
Exorista vetula, *Mg.*—Felden, 28. v. 96.
E. cheloniæ, *Rnd.*—*Felden, 15. vii. 96.
E. fimbriata, *Mg.*—Felden, 7. vi. 94.
E. notabilis, *Mg.*—Felden, 23. vi. 93.
E. perturbans, *Ztt.*—*Felden, 10. vi. 99.
E. jucunda, *Mg.*—Felden, 1. vi. 96.
E. lucorum, *Mg.*—*Felden, 1. ix. 96.
Blepharomyia pagana, *Mg.* (Exorista amplicornis, *Meade*).—*Felden, 2. vii. 98.
Epicampocera succincta, *Mg.*—Felden, 4. v. 93.
E. ambulans, *Mg.*—Felden, 3. v. 94.
Nemorilla floralis, *Pand.* (maculosa, *Mg.*).—*Felden, 3. vii. 96.
Blepharidea vulgaris, *Fln.*—Felden, 7. vi. 94.
Myxexorista (Exorista) fauna, *Mg.*—*Felden, 21. vi. 96.
M. libatrix, *Br. & v. Berg.*—Felden, 28. ix. 94.
Frontina nigricans, *Egg.*—*Felden, 1. ix. 98.
Phorocera cilipeda, *Rnd.*—Felden, 24. x. 92.
Bothria assimilis, *Fln.*—Felden, 7. vi. 94.
B. cæsifrons, *Mcq.*—Felden, 11. v. 93.
Chætolyga analis, *Mcq.*—4. viii. 93.
C. amœna, *Mg.*—*Felden, 2. v. 97.
C. quadripustulata, *F.*—Felden, 13. vi. 94.
C. nigrithorax, *Egg.*—*Felden, 14. vii. 98.
Tachina agilis, *Desv.*—*Felden, 17. vi. 92.
Perichæta unicolor, *Fln.*—*Felden, 11. v. 97.
Gonia fasciata, *Mg.*—Tring, *A.P.*, 26. iv. 97.
G. divisa, *Mg.*—Tring, *A.P.*, 26. iv. 97.
Thelymorpha (Baumhaueria) marmorata, *F.* (vertiginosa, *Fln.*).—Felden, 10. v. 93.
Brachychæta spinigera, *Rnd.*—Felden, 5. iv. 92.
Aporomyia dubia, *Fln.*—Felden, 16. iv. 93.
Somolia rebaptizata, *Rnd.*—Felden, 2. v. 93.
Mintho præceps, *Scop.* (compressa, *Br. & v. Berg.*).—Tring, *Grant*, 21. vi. 96.
Melanota volvulus, *F.*—Felden, 3. vii. 96.

Pelatachina (Hyria) tibialis, *Fln.*—Felden, 15. v. 94.
Macquartia dispar, *Fln.*—*Tring, *A.P.*, 3. vii. 97; *Felden, 29. vi. 97.
M. tenebricosa, *Mg.*—*Felden, 8. vii. 97.
M. grisea, *Fln.*—*Felden, 26. x. 98.
M. olizon, *Walk.* (? cœlebs, *Rnd.*).—Felden, 4. viii. 94.
M. ? nitida, *Ztt.* — *Felden, 21. vi. 95.
Loewia setibarba, *Egg.* (brevifrons, *Rnd.*). — *Felden, 9. viii. 98.
Ptilops chalybeata, *Mg.*—Felden, 27. v. 93.
Degeeria ornata, *Mg.* (collaris, *Fln.*).—Tring, *A.P.*, 22. vi. 96.
D. pulchella, *Mg.* (medorina, *Schin.*).—*Felden, 28. vi. 96.
D. muscaria, *Fln.*—*Felden, 9. vi. 99.
Thelaira leucozona, *Pz.*—Felden, 4. vii. 93.
T. nigripes, *F.*—Felden, 13. vii. 94.
Myiobia fenestrata, *Mg.*—Felden, 9. v. 93.
M. inanis, *Fln.*—Felden, 26. vii. 93.
M. pacifica (*Mg.*), *Sch.* ?—Felden, 11. v. 93.
Olivieria lateralis, *F.*—Aldbury, *A.E.G.*, viii. 05; Felden, 4. vi. 93.
Varichæta (Erigone) radicum, *F.*—Felden, 4. viii. 93; Pré Wood, 25. vi. 04.
V. strenua, *Mg.* (conjuncta, *Wlk.*).—Pré Wood, vi. 04.
V. vagans, *Mg.*—*Felden, 28. v. 99.
V. rudis, *Fln.* (strenua, *Mg.*).—Felden, 24. v. 93.
V. (Nemocera) nemorum, *Mg.*—*Felden, 1. viii. 97.
V. consobrina, *Mg.*—*Felden, 23. vii. 96.
V. appendiculata, *Mcq.*—*Felden, 17. viii. 98.
Erigone sp. (labelled "genus *Panzeria*, *Rob-Desv.*, near *rudis* but distinct," *E.E.A.*).—Felden, 24. iv. 93.
Tachina (Echinomyia) fera, *L.*—Felden, 24. vii. 93.
Plagia ruralis, *Fln.*—Felden, 7. v. 93.
P. curvinervis, *Ztt.*—*Felden, 11. vi. 96.
P. trepida, *Mg.*—Felden, 5. v. 93.

Thryptocerinæ.

Phorichæta tricincta, *Rnd.*—Felden, 22. v. 94.
Ptychoneura rufitarsis, *Mg.*—Felden, 19. vi. 94.
Rœselia pallipes, *Fln.* (antiqua, *Mg.*).—Felden, 4. viii. 93.
Digonochæta (Bigonochæta) spinipennis, *Mg.*—*Felden, 30. vi. 97.
D. sp.—Tring, *N. C. Rothschild*, 07, "bred from Sesia andræniformis."
D. sp.—*Felden, 19. vii. 97.
Thryptocera cognata, *Schin.* (Discochæta evonymellæ, *Ratzeb.*).—*Felden, 4. v. 97.
T. latifrons, *Mg.*?—Felden, 13. vi. 94.
T. broteas, *Walk.*, 'List Dipt. Ins. Brit. Mus.,' iv (1849), p.763 (pilipennis, *Fln.*, ♂♂ = crassicornis, *Ztt.* nec *Mg.*).—Felden, 25. vii. 93.
T. minutissima, *Ztt.*—*Felden, 6. viii. 99.
Siphona cristata, *F.*—*Tring, *A.P.*, 16. iv. 97; Felden, 27. iv. 93.
S. geniculata, *Deg.*—Felden, 24. x. 92.

Phasinæ.

Phasia rothi, *Ztt.*?—Felden, 14. v. 94. and 20. v. 99. The earlier specimen shows certain differences, and Mr. E. E. Austen thinks that a new genus ought probably to be founded for the species to which this specimen belongs."

Alophora obesa, *F.*—Felden, 29. vi. 94.

A. pusilla, *Mg.*—Felden, 27. vi. 93.

Trixinæ.

Trixa œstroidea, *Dsv.*—Felden, 16. v. 93.

Fortisia fœda, *Mg.*—Felden, 9. viii. 94.

Phyto melanocephala, *Mg.*—Tring, *A.P.*, 29. vi. 95.

Rhinophoria melania, *Mg.*—*Felden, 29. ix. 97.

R. simplicissima, *Lw.*—*Felden, 25. vii. 99.

Frauenfeldia rubricosa, *Mg.*—Tring, *A.P.*, vii. 97.

Brachycoma devia, *Fln.*—Felden, 26. iv. 93.

Clista mœrens (*Mg.*), *Meade.*—Felden, 28. vii. 94.

C. senescens (*Ztt.*), *Meade.*—Felden, 29. vii. 94.; *Tring, *A.P.*, 11. viii. 98.

Sarcophaginæ.

Cynomyia mortuorum, *L.*—Berkhamsted, *Grant*, 30. vi. 95.

Onesia (Cynomyia) sepulchralis, *L.*—Felden, 2. v. 93.

Sarcophaga carnaria, *L.*—Aldbury, *A.E.G.*, ix, 04; Felden, 28. ix. 93; St. Albans, 27. viii. 04.

S. ? albiceps, *Mg.*—St. Albans, viii. 04.

S. agricola, *Meade* (? *Desv.*).—Felden, *E. E. Austen*, 8. vii. 94.

S. hæmatodes, *Mg.*—Felden, 11. v. 93.

S. offuscata (*Mg.*), *Schin.*—Felden, 29. iv. 93.

S. erythrura, *Mg.*?—Felden, *E. E. Austen*, 8. vii. 94.

Nyctia halterata, *Pz.*—Felden, 4. v. 93; Cheshunt, *Jennings*.

Anthracomyia (Melanomyia) nana, *Mg.*—Felden, 16. vi. 94.

Metopodia sp.—Felden, 10. vii. 94 and 14. vii. 94.

Metopia ? campestris, *Fln.*—*Felden, 17. vii. 96.

M. argyrocephala, *Mg.*—*Herts, *A.P.*, 17. vii. 96. ("Felden" struck out.)

M. leucocephala, *Rossi.*—Herts, *A.P.*, 8. vii. 95. ("Felden" struck out.)

M. nigricans.—*Felden, 13. vii. 99.

Nemorœa appendiculata, *Mcq.*—*Felden, 17. vii. 99.

Dexinæ.

Dexiosoma (Dexia) caninum, *F.*—*Felden, 16. vii. 99.

Prosena ? sybarita, *F.*—*Tring, *A.P.*, 3. vii. 96.

P. ? longirostris, *Egg.*—*Tring, *A.P.*, 10. vii. 97.

Dinera grisescens, *Fln.*—Felden, 4. viii. 94.

Mycocera carinifrons, *Fln.*—Felden, 13. viii. 94.

Muscidæ.

Stomoxys calcitrans, *L.*—Felden, 16. vii. 98.
Hæmatobia stimulans, *Mg.*—Felden, 5. v. 93.
H. irritans, *L.* (serrata, *Desv.*).—Felden, 5. ix. 95.
Pollenia vespillo, *F.*—Aldbury, *A.E.G.*, 30. viii. 04; Felden, 22. iii. 93.
P. rudis, *F.*—Felden, 23. ii. 93; St. Albans, v. 04; var. (varia, *Mg.*).—Felden, 24. viii. 93.
Myiospila meditabunda, *F.*—Felden, 20. iv. 93.
Musca domestica, *L.*—Generally common.
M. corvina, *F.*—St. Albans.
Cyrtoneura stabulans, *Fln.*—Felden, 26. v. 93; Bushey Heath, *Barraud*, 4. iii. 06.
C. simplex, *Lw.*—Felden, 26. iv. 93.
C. pabulorum, *Fln.*—Felden, 20. ix. 93.
C. pascuorum, *Mg.*—*Felden, 23. viii. 97.
C. cæsia, *Mg.*—Felden, 20. ix. 93.
Morellia (Cyrtoneura) curvipes, *Mcq.*—*Felden, 4. ix. 98.
M. hortorum, *Fln.*—*Felden, 2. ix. 98.
Mesembrina meridiana, *L.*—Tring, *N. C. Rothschild*, 14. x. 06; Aldbury, *Furnival*, 30. vii. 05.
Pyrellia ? eriophthalma, *Mcq.*—Felden, 27. vi. 93.
Protocalliphora (Calliphora) azurea, *Fln.*—Felden, 7. vii. 93; St. Albans, x. 03.
P. (C.) grœnlandica, *Ztt.*—Boxmoor, *A.P.* (undated).
Calliphora cognata, *Mg.*—Felden, 22. iii. 93.
C. erythrocephala, *Mg.* (blow-fly or blue-bottle).—Generally common.
C. vomitoria, *L.*—St. Albans, ix. 03.
C. micans, *Mg.*—Felden, 28. iv. 93.
Euphoria (Lucilia) cornicina, *F.*—Aldbury, *A.E.G.*; Felden, 10. xi. 96; Kitchener's Meads, v. 05.
Lucilia cæsar, *L.* (green bottle-fly).—Felden, 14. vii. 94; Kitchener's Meads, 27. viii. 04.
L. sericata, *Mg.*—Aldbury, *A.E.G.*, ix. 04; St. Albans, viii. 04.

Anthomyidæ.

Mydæinæ.

Polietes lardaria, *F.*—St. Albans, ix, 03; Eastbury, *W. Wesché*, 14. vi. 99.
P. albolineata, *Fln.*—St. Albans, 04.
Hyetodesia incana, *W.*—*Felden, 4. vii. 97.
H. lucorum, *Fln.*—Felden, 5. v. 96.
H. marmorata, *Ztt.*—*Felden, 20. vi. 99.
H. Goberti, *Mik.* (dubia, *Meade*).—Felden, 24. viii. 97.
H. obscurata, *Mg.*—*Felden, 5. vi. 97.
H. longipes, *Ztt.*—St. Albans, vi. 06.
H. umbratica, *Mg.*—Felden, 7. vi. 97.
H. semicinerea, *W.*—*Felden, 4. vii. 99.
H. læta, *Fln.*—*Felden, vii. 98.
H. perdita, *Mg.*—Felden, 1. viii. 97.
H. errans, *Mg.*—Felden, v. 96.

H. signata, *Mg.*—Felden, 3. viii. 97.
H. lasiophthalma, *Mcq.*—Felden, 12. viii. 97; Eastbury, *W. Wesché*, vi. 01.
H. erratica, *Fln.*—Eastbury, *W. Wesché*, 24. vi. 01.
H. basalis, *Ztt.*—Felden, 10. vi. 97; Pré Wood, vi. 04; Kitchener's Meads.
H. rufipalpis, *Mcq.*—*Felden, 23. ix. 98.
H. scutellaris, *Fln.*—Felden, 3. xi. 96; St. Albans, vi. 04.
H. pallida, *F.*—Berkhamsted, *Grant*, 30. vi. 95; Felden, 25. vi. 97.
H. trigonalis, *Mg.*—*Tring, *A.P.*, 6. v. 98; *Felden, 11. x. 97.
H. variegata, *Mg.*—*Felden, 14. iv. 98.
H. diaphana, *W.*—Felden, 19. vii. 97.
H. (Trichopticus) semipellucida, *Ztt.*—*Felden, 10. vii. 98.
H. (Allœostylus) simplex, *W.*—*Felden, 12. x. 97.
A. (Hyetodesia) flaveola, *Fln.*—Felden, 13. vi. 97.
Mydæa vespertina, *Fln.*—Felden, 4. v. 97.
M. allotalla, *Mg.*—*Tring, 12. viii. 97; *Felden, 17. vii. 99.
M. urbana, *Mg.*—St. Albans, 30. v. 05; *Felden (marked "? urbana"), 13. x. 97; var., *Felden, 13. x. 97.
M. pagana, *F.*—Felden, 20. x. 96.
M. affinis, *Meade.*—*Felden, 14. vii. 98.
M. nigricolor, *Fln.*—*Felden, 13. x. 97.
M. (Spilogaster) impuncta, *Fln.*—Felden, 30. viii. 97.
M. separata, *Mg.*—*Felden, 19. vi. 98.
M. lineata.—*Felden, 19. vi. 98.
Sphecolyma inanis, *Fln.*—Felden (undated).
Spilogaster notata, *Fln.*—*Felden, 20. vi. 98.
S. quadrimaculata, *Fln.*—*Tring, *A.P.*, 24. iv. 98.
S. (Spilomyia) duplicata, *Mg.*—*Tring, *A.P.*, 15. vi. 97.
S. communis, *Dsv.*—Felden, 20. vi. 97; var., Felden, 9. vii. 98.
S. denigrans, *Ztt.*—Felden, 30. viii. 97; Tring, *A.P.*, 22. ix. 97.
S. carbonella, *Ztt.*—Felden, 16. viii. 98.
S. tetrastigma, *Mg.*—*Tring, 10. vii. 97.
S. uliginosa, *Fln.*—Felden, 10. ix. 93.
S. pertusa, *Mg.*—*Felden, 9. vi. 98.
S. quadrum, *F.*—*Felden, 2. viii. 97.
S. tincta, *Ztt.*—*Felden, 24. vii. 96.
Melanochila riparia, *Fln.*—Felden, 15. v. 97.
Hydrotæa ciliata, *F.*—*Felden, 17. vii. 99.
H. occulta, *Mg.*—Felden, 13. v. 98.
H. curvipes, *Ztt.*—*Felden, 26. vii. 99.
H. cyrtoneurina, *Ztt.*—Felden, 13. x. 97.
H. irritans, *Fln.*—Berkhamsted, *Grant*, 30. vi. 95.
H. dentipes, *F.*—Felden, 13. iv. 93.
H. meteorica, *L.*—Felden, 2. v. 93.
H. armipes, *F.*—Felden, 22. iv. 93.
H. albipuncta, *Ztt.*—Felden, 30. v. 97.
H. glabricula, *Fln.*—*Felden, 21. vii. 99.
Ophyra leucostoma, *W.*—St. Albans, vi. 04.

O. anthrax, *Mg.*—*Felden, 23. vi. 98.
Drymia hamata, *Fln.*—Felden, vii. 97.
Trichopticus cunctans, *Mg.*—Felden, 24. v. 98.

Anthomyinæ.

Hydrophoria conica, *W.*—Felden (undated).
Hylemyia virginea, *Mg.*—*Felden, 19. vi. 98.
H. variata, *Fln.*—Felden, 6. vi. 97.
H. seticrura, *Rnd.*—Tring, *A.P.*, 14. vii. 97; Felden, 9. vii. 97.
H. cardui, *Mg.*—*Felden, 7. vi. 98.
H. nigrescens, *Rnd.*—*Felden, 7. vii. 98.
H. pullula, *Ztt.*—Felden, 28. vi. 97.
H. cinerosa, *Ztt.*—*Felden, 14. v. 98.
H. strigosa, *F.*—Felden, 27. iv. 97.
H. præpotens, *W.*—Felden (undated).
H. coarctata, *Fln.*—*Felden, 30. vi. 98.
Eustalomyia histrio, *Ztt.*—*Felden, 25. viii. 98.
E. sp.—*Felden, vi. 03, "bred from boring of *Pemphredon*."
Mycophaga fungorum, *Deg.*—Felden, 17. v. 99.
Lasiops Rœderi, *Kow.*—*Felden, 21. vi. 98.
L. ctenoctema, *Kow.*—*Felden, 3. v. 98; *Tring, *A.P.*, 6. v. 98.
L. Meadii, *Kow.*—Felden, 13. iii. 99.
Anthomyia radicum, *L.*—Felden, 7. v. 97.
A. sulciventris, *Ztt.*—*Tring, *A.P.*, 16. iv. 98.
Chortophila buccata, *Fln.*—*Felden, 16. v. 98.
C. unilineata, *Ztt.*—*Felden, 4. v. 98.
C. albescens, *Ztt.*—*Felden, 10. vii. 99.
C. cinerea, *Fln.*—*Felden, 7. viii. 97.
C. cinerella, *Fln.*—*Tring, *A.P.*, 25. vi. 98.
C. curvicauda, *Ztt.*—*Felden, 16. v. 98.
C. trapezina, *Ztt.*, *Meade.*—*Tring, *A.P.*, 2. vi. 97; Felden, 23. vi. 98.
C. sepia, *Mg.*—*Felden, 23. iv. 98.
Phorbia floccosa, *Mcq.*, *Meade* (Anthomyia floralis, *Fln.*) (radish-fly).—Felden, 1. v. 97; St. Albans, 1883, *F. W. Silvester* in 'Herts Trans.'
P. discreta, *Mg.*—Felden, 13. v. 98.
P. pudica, *Rnd.*—*Felden, 14. v. 98.
P. lactucæ, *Buché.*—Felden, 20. vi. 97.
P. muscaria, *Mg.*—Felden, 20. iii. 97, "from palm-willow."
P. cilicrura, *Rnd.* — Tring, *A.P.*, 2. v. 97; Felden, 18. iv. 98.
P. trichodactyla, *Rnd.*—*Felden, 14. v. 98.
P. florilega, *Ztt.*—*Felden, 7. iv. 98.
P. ignota, *Rnd.*—*Felden, 27. vi. 97.
P. neglecta, *Meade.*—Felden, 13. iv. 99.
P. versicolor, *Mg.*—*Tring, *A.P.*, 22. ix. 97; Felden, 20. v. 99.
P. cepetorum, *Meade* (Anthomyia ceparum, *Mg.*)

(onion-fly).—Harpenden, 1881, *Willis* in 'Herts Trans.'
Pegomyia conformis, *Fln.*—*Felden, 7. viii. 97.
P. rufipes, *Fln.*—*Felden, 17. ix. 97.
P. transversa, *Fln.*—*Felden, 29. x. 98.
P. latitarsis, *Ztt.*—Felden, 5. vii. 97.
P. bicolor, *W.*—Felden, 1. vi. 94.
P. nigritarsis, *Ztt.*—St. Albans, v. 04.
P. silacea, *Mg.*—*Felden, 12. x. 97.
P. Winthemi, *Mg.*—*Felden, 22. viii. 97.

Homalomyinæ.

Homalomyia hamata, *Mcq.*—Felden, 2. vi. 97.
H. fuscula, *Fln.*—*Felden, 1. vii. 97.
H. (Faunia) pretiosa, *Schin.*—*Felden, 11. viii. 99.
H. manicata, *Mg.*—Felden, 6. vi. 97.
H. scalaris, *F.*—*Felden, 7. iv. 98.
H. armata, *Mg.*—Felden, 10. vi. 97.
H. aërea, *Ztt.* (carbonaria, *Rnd.*, *Meade*).—Felden, 21. vi. 99.
H. sociella, *Ztt.*—*Felden, 28. v. 98.
H. serena, *Fln.*—*Felden, 1. vii. 99.
H. corvina, *Verr.*—Felden, 20. v. 99.
H. incisurata, *Ztt.*—Felden, 2. viii. 97.
H. mutica, *Ztt.*—*Felden, 21. v. 98.
Azelia Macquarti, *Stæg.*—Felden, 6. v. 97.
A. Zetterstedti, *Rnd.*—Felden, 2. x. 97.
A. triquetra, *W.*—Felden, 9. v. 97.
Cœlomyia mollissima, *Hal.*—Felden, 8. v. 99.

Cœnosinæ.

Caricea tigrina, *F.*—Felden, 6. vi. 97.
C. humilis, *Mg.*—Felden, 22. v. 99.
C. alma, *Mg.* (ungulata, *Rnd.*).—*Felden, 13. iii. 99.
Allognota agromyzella, *Rnd.*—Felden, 25. v. 99.
Cœnosia sexnotata, *Mg.*—Felden, 18. vi. 97.
C. genualis, *Rnd.*—*Felden, 28. v. 98.
Hoplogaster mollicula, *Fln.*—Felden, 22. vii. 97.
H. (Cœnosia) tricolor, *Ztt.*—Felden, 16. v. 99.
Lispe tentaculata, *Deg.*—30. iii. 93.
L. litorea, *Fln.*—*Felden, 20. ix. 98.
L. nana, *Mcq.* (pulchella, *Lw.*).—Felden, 1. x. 98.

CORDYLURIDÆ.

Cordylura umbrosa, *Mg.*—Kitchener's Meads, v. 05.
Parallelomma (Cordylura) albipes, *Fln.*—*Felden, 8. vi. 93.
Cnemopogon apicalis, *Mg.*—*Felden, 12. v. 99.
Amaurosoma fasciata, *Mg.*—*Felden, 12. v. 99.
A. cinerea, *Ztt.*—*Felden, 20. v. 99.

Norellia spp.—*Felden, 22. ix. 98 and 8. x. 98.
Trichopalpus fraternus, *Mg.*—*Felden, 22. vi. 99.
T. punctipes, *Mg.*—*Felden, 22. vi. 99.
Scatophaga inquinata, *Mg.*—*Felden, 8. x. 98; St. Albans, v. 04.
S. merdaria, *F.* (stercoraria, *L.*).—*Felden, 21. vi. 99; St. Albans, iv. 04.

HELOMYZIDÆ.

Helomyza rufa, *Fln.* (variegata, *Lw.*).—Felden, 30. vii. 99.
H. inornata, *Lw.* (det. *Collin*).—*Felden, 4. iv. 02.
H. montana, *Lw.*—*Felden, 20. x. 98.
H. flavifrons, *Ztt.* (det. *Collin*).—*Felden, 18. x. 97.
H. pallida, *Fln.*—*Felden, 5. viii. 99.
Blepharoptera ruficauda, *Ztt.*—*Felden, 28. iv. 99.
B. serrata, *L.*—*Felden, 7. xi. 99.
B. sp.—*Felden, 29. xi. 96.
Tephrochlamys rufiventris, *Mg.*—Felden, 13. xi. 96.
T. flavipes, *Ztt.*—*Felden, 13. xi. 96.

HETERONEURIDÆ.

Heteroneura (spp. nov., *J. E. Collin*).—*Felden, 15. v. 93 and 18. vi. 93.
H. rufipes.—*Felden, 28. ix. 01.

SCIOMYZIDÆ.

Dryomyza flaveola, *F.*—St. Albans, ix. 03.
D. Zawadzkii, *Schumm.* (? præc. var.).—Felden, 10. xi. 96.
D. hamata.—*Felden, 29. vii. 98.
Neuroctena (Dryomyza) anilis, *Fln.*—Felden, 10. x. 97.
Sciomyza nigrimana, *Mg.*—*Felden, 5. vii. 99.
S. cinerella, *Fln.*—Felden, 18. v. 93.
S. dubia, *Fln.*—Felden, 8. v. 93.
S. nana, *Fln.*—*Felden, 13. x. 98.
S. rufiventris, *Mg.* (ventralis, *Fln.*).—*Felden, 5. x. 98.
S. lata, *Schin.*—*Felden, 3. x. 98.
S. longipennis.—*Felden, 10. vi. 99.
Tetanocera elata, *F.*—Felden, 12. vi. 93.
T. lævifrons, *Lw.*—Felden, 23. ix. 97.
T. ferruginea, *Fln.*—Felden, 4. vi. 93.
T. coryleti, *Scop.* (reticulata, *F.*).—*Felden, 2. vii. 99.
T. punctulata, *Scop.*—Tring, *Furnival*, 29. viii. 03; Felden, 27. v. 93.
Limnia unguicornis, *Scop.*—Felden, 2. vi. 93.
L. obliterata, *F.*—Felden, 6. ix. 97.
Elgiva dorsalis, *F.*—Felden, 7. ix. 99.
Sepedon sphegeus, *F.*—Felden, 14. ix. 99.

PSILIDÆ.

Psila fimetaria, *L.*—Kitchener's Meads, v. 04.
P. rufa, *Mg.*—Felden, 17. v. 93.
P. debilis, *Egg.*—*Felden, 9. v. 99.
P. nigricornis, *Mg.*—Felden, 3. v. 93.
Chyliza leptogaster, *Ps.*—Felden, 18. v. 93.

Loxocera albiseta, *Schrk.*—Felden, 23. ix. 97; Bricket Wood, *A.P.*, 22. vii. 96.

Lissa loxocerina, *Fln.*—Felden, 10. vii. 98.

Micropezidæ.

Micropeza corrigiolata, *L.*—Felden, 23. v. 93.

Calobata ephippium, *F.*—Felden, 23. viii. 99.

C. petronella, *L.*—Felden, 18. v. 93; Kitchener's Meads.

Ortalidæ.

Ortalinæ.

Dorycera graminum, *F.*—Felden, 6. vi. 97.

Pteropæctria nigrina, *Mg.*—Felden, 13. vii. 99.

P. frondescentiæ, *L.*—Felden, 6. vii. 99.

Platysominæ.

Platysoma seminationis, *F.*—Tring, *Grant*, 21. vi. 96; Felden, 5. vi. 98; St. Albans, vi. 04.

Ulidinæ.

Seoptera vibrans, *L.*—Felden, 25. v. 93.

Ulidia erythrophthalma, *Mg.*—*Felden, 10. vii. 99.

Ulidia sp.—*Felden, 6. vii. 94.

Trypetidæ.

Acidia cognata, *W.*—Felden, 21. viii. 99.

A. heraclei, *L.* (Tephritis onopordinis, *F.*) (parsnip-leaf miner-fly).—Recorded in 'Herts Trans.' as doing great damage in 1883, by *J. J. Willis* at Harpenden, *F. W. Silvester* at St. Albans, and *A. T. Brett* at Watford; Felden, 3. v. 98.

Spilographa zoë, *Mg.*—Tring, *A.P.*, 11. viii. 98; Felden, 5. vi. 98; Kitchener's Meads, v. 05.

Trypeta onotrophes, *Lw.*—Felden, 18. vii. 96.

T. tussilaginis, *F.*—Felden, 10. viii. 98.

Urophora solstitialis, *L.*—Felden, 17. vi. 96.

Sphenella marginata, *Fln.*—Felden, 21. vii. 99.

Ensina sonchi, *L.*—Felden, x. 92.

Tephritis miliaria, *Schrk.*—Berkhamsted, *Grant*, 30. vi. 95; Felden, 7. vii. 93.

T. proboscidea, *Lw.*—Felden, 25. vii. 99.

T. formosa, *Lw.*—Felden, 20. x. 92.

T. hyoscyami, *L.*—Felden, 24. ii. 99.

T. ruralis, *Lw.*—Felden, 23. x. 92.

T. vespertina, *Lw.*—Felden, 20. x. 92.

T. bardanæ, *Schrk.*—Felden, 1. xi. 92.

Euaresta conjuncta, *Lw.*, var. —Felden, 15. ii. 99.

Lonchæidæ.

Lonchæa vaginalis, *Fln.*—*Felden, 2. iv. 92.
L. chorea, *F.*—*Felden, 30. vii. 98.
Palloptera ustulata, *Fln.*—Felden, 27. viii. 94.
P. umbellatarum, *F.*—Aldbury, *A.E.G.*; Felden, 1. vii. 93.
P. parallela, *Lw.*—Felden, 27. vii. 98.
P. arcuata, *Fln.*—Felden, 15. v. 93.

Sapromyzidæ.

Sapromyza lupulina, *F.*—Felden, 6. vi. 98.
S. fasciata, *Fln.*—Felden, 10. vii. 99.
S. inusta, *Mg.*—Felden, 14. vii. 93.
S. decempunctata, *Fln.*—Felden, 6. vi. 99; Kitchener's Meads.
S. pallidiventris, *Fln.*—Felden, 29. vi. 93.
S. præusta, *Fln.*—Felden, 17. vi. 93.
S. difformis, *Lw.*—Felden, 7. vii. 99.
There are several undetermined species of *Sapromyza* dated 1899.

Opomyzidæ.

Balioptera tripunctata, *Fln.*—Felden, 20. v. 98.
B. combinata, *L.*—Felden, 23. x. 92.
Opomyza germinationis, *L.*—Felden, 11. vi. 93; Kitchener's Meads.
O. florum, *F.*—Felden, 5. x. 98.
Pelethophila flava, *L.*—Felden, 7. viii. 99.

Sepsidæ.

Sepsis flavimana, *Mg.*—*Felden, 21. iii. 97.
Nemopoda cylindrica, *F.*—Felden, 18. v. 93.
Themira putris, *L.*—Felden, 7. vii. 99.
T. superba, *Hal.*—Felden, 21. vii. 99.
T. minor, *Hal.*—Felden, 20. ix. 98.
T. sp. near Falleni, *Stæg.*—Felden, 21. vi. 99.
Saltella scutellaris, *Fln.* ?—Two specimens from Felden, 23. vi. 99, Mr. E. E. Austen thinks "agree generally very well with the description, but the posterior basal cell is fused with the anterior basal instead of with the discal cell (thus disagreeing with Schiner's diagnosis of the genus *Saltella*), and the transverse veins are not noticeably approximate."

Piophilidæ.

Piophila sp.—*Felden, 29. iv. 99.
Madiza glabra, *Fln.*—*Felden, 18. iii. 97.
M. glabricula and M. rubritarsis.—These two species are in the unincorporated collections at S. Kensington.

GEOMYZIDÆ.

Diastata, ? undescribed.—*Felden, 8. x. 98.

EPHYDRIDÆ.

Notiphilinæ.

Notiphila nigricornis, *Stnh.*—*Felden, 2. xi. 92.
N. stagnicola, *Mcq.*—*Felden, 7. vii. 99.
N. maculata, *Stnh.*—*Felden, 12. vii. 99.
N. venusta, *Lw.*—*Felden, 24. ix. 98.
N. riparia, *Mg.*—*Felden, 30. vi. 99.
N. cinerea, *Fln.*—*Felden, 26. ix. 98.
N. annulipes, *Stnh.*—*Felden, 22. vi. 99.
N. ornaticollis.—*Felden, 16. vi. 99.
Ephygrobia obscuripes, *Lw.*—*Felden, 27. xi. 98.
E. (Psilops) nitidula, *Fln.*—*Felden, 21. xi. 92.
E. (Clasiopa) plumosa, *Fln.*—*Felden, 20. xi. 96.
Clasiopa calceata, *Mg.*—*Felden, 6. xii. 98.
Trimerina madizans, *Fln.*—Felden, 2. xi. 92.
Discomyza incurva, *Fln.*—Felden, 22. viii. 94.
Anthyroglossa glabra, *Mg.*—*Felden, 17. x. 98.

Hydrellinæ.

Hydrellia albilabris, *Mg.*—*Chipperfield, *A.P.*, 10. xi. 92.
H. thoracica, *Hal.*—*Felden, 28. ix. 98.
H. griseola, *Fln.*—*Felden, 3. xi. 93.
H. fulviceps, *Stnh.* (chrysostoma, *Mg.*). —*Felden, 28. ix. 98.
H. ranunculi, *Hal.*—*Felden, 5. xi. 92.
H. albiceps, *Mg.*—*Felden, 24. x. 98.
H. lamina, *Beck.*—*Felden, 26. ix. 98.
H. nitida, *Desv.*—*Felden, 26. ix. 98.
H. ? modesta, *Lw.*—*Felden, 8. x. 98.
H. flavicornis, *Fln.*—*Felden, 8. vii. 99.
H. undescribed.—*Felden, 8. x. 99.
Philhygria stictica, *Mg.*—*Felden, 26. x. 98.
Hyadina guttata, *Fln.*—*Felden, 24. ix. 98.
Pelina ænea, *Fln.*—*Felden, 1. xi. 92.

Ephydrinæ.

Canace ranula, *Lw.*—*Felden, 3. x. 98.
Parhydra fossarum, *Hal.*—*Felden, 28. ix. 98; var., *Felden, 24. x. 98.
P. quadripunctata, *Mg.*—*Felden, 21. x. 98.
P. aquila, *Fln.*—*Felden, 1. iv. 93.
P. coarctata, *Fln.*—*Felden, 3. ii. 93; var., *Felden, 3. ii. 93.
P. undescribed.—*Felden, 24. ix. 98.
Ephydra micans, *Hal.*—*Felden, 15. iii. 93.
Cænia palustris, *Fln.* (?).—*Felden, 21. xi. 92.

Cænia sp.—*Felden, 5. x. 98.
Scatella quadrata, *Fln.*—Felden, 15. xi. 96.
S. sibilans, *Hal.*—*Felden, 27. xi. 98.
S. sorbillans, *Hal.* (paludum, *Mg.*).—*Felden, 24. x. 98.
S. stagnalis, *Fln.*—*Felden, 26. ix. 98.
S. ? crassicosta, *Beck.*—*Felden, 10. vi. 99.
Scatophila despecta, *Hal.*—*Felden, 1. x. 98.
S. ? pallerata.—*Felden, 14. viii. 99.
S. spp.—*Felden, 19. x. 97.

Drosophilidæ.

Drosophila melanogaster, *Mg.*—*Felden, 1. iv. 99.
D. funebris, *F.*—Felden, 6. xi. 92.

Chloropidæ.

Meromyza pratorum, *Mg.*—*Felden, 5. vii. 99.
M. ? saltatrix, *L.*—*Felden, 30. vi. 99.
M. variegata, *Mg.*—*Felden, 12. vii. 99.
M. læta, *Mg.*—Felden, 29. vi. 93.
M. reflecta (?).—*Felden, 7. vii. 99.
Chlorops (Centor) cereris, *Fln.*—*Felden, 5. vi. 99.
C. (Diplotoxa) messoria, *Fln.*—*Felden, 6. vii. 99.
C. tæniopus, *Mg.* — Bishops Stortford, *J. C. Mann* in 'Herts Trans.'
C. sp.—*Felden, 21. v. 99.
Oscinis ? maura, *Fln.*—*Felden, 30. vi. 99.
O. sp.—*Felden, 4. vii. 99.
Elachyptera brevipennis, *Mg.*—Gadesbridge, *A.P.*, 21. xi. 92.
E. cornuta, *Fln.*—Felden, 11. ii. 97.

Milichidæ.

Phyllomyza flavitarsis, *Mg.*—*Felden, 1. vi. 98.
P. tarsalis (?).—*Felden, 22. v. 99.

Agromyzidæ.

Agromyza nigripes, *Mg.*—*Felden, 10. iv. 97.
A. carbonaria, *Ztt.*—*Felden, 23. vi. 99.
A. reptans, *Fln.*—*Felden, 24. v. 99.
A. ? Schineri, *Giraud.*—*Felden, 31. viii. 98.
A. cunctans, *Mg.*—*Felden, 9. viii. 99.
Leucopis spp.—*Felden, 9. iv. 97 and 7. iii. 99.
Ochthiphila aridella, *Fln.*—*Felden, 30. vi. 99.
Schœnomyza litorella, *Fln.*—*Felden, 1. x. 98.

Phytomyzidæ.

Phytomyza albipennis, *Fln.*—*Felden, 22. iv. 97.
P. flavo-scutellata, *Fln.*—*Felden, 20. xi. 96.
P. lateralis, *Fln.*—*Felden, 10. i. 93, "from larvæ mining in leaves of greenhouse *Cineraria*."
P. flavomaculata, *Fln.*—*Felden, 27. iv. 93.
P. (Chromatomyia) obscurella, *Fln.*—*Felden, 27. iv. 93.

P. Zetterstedtii, *Schin.* (maculipes, *Ztt.*).—*Felden, 22. iv. 97.
P. præcox, *Mg.*—*Felden, 9. iv. 97. The following note is attached to this specimen: "The species labelled *præcox* has palish basal joints to antennæ and is perhaps *Zetterstedtii*."
P. flavicornis, *Fln.*—*Felden, 27. iv. 93.
P. affinis, *Fln.*—*Felden, 11. iv. 97.
P. ? sp.—*Felden, 2. v. 97, and several unnamed specimens.

ASTIADÆ.

Astia amœna, *Mg.*—Felden, 28. x. 97.

BORBORIDÆ.

Borborus nitidus, *Mg.*—*Felden, 26. x. 93.
B. niger, *Mg.*—*Felden, 93.
B. suillorum, *Hal.*—*Felden, 12. i. 97.
B. Roseri, *Rnd.*—*Felden, 21. xi. 96.
B. pallifrons, *Fln.*—*Felden, 21. xi. 96.
B. longipennis, *Hal.*—*Felden, 21. xi. 96.
B. equinus, *Fln.*—*Felden, 22. xi. 93; var., Felden, 25. iii. 97.
B. sp. (similis, *Collin* MS.).—*Felden, 21. xi. 96.
Sphærocera subsultans, *F.*—*Felden, 21. xi. 96.
S. ? denticulata, *Mg.*—*Felden, 21. xi. 96.
S. vaporariorum, *Hal.*—*Felden, 30. xi. 96.
S. pusilla, *Fln.*—*Felden, 24. xi. 96.
Limosina lugubris, *Hal.*—*Felden, 27. ii. 96.
L. vagans, *Hal.*—*Felden, 11. ii. 97.
L. ferruginata, *Stnh.*—*Felden, 26. ii. 97.
L. fontinalis, *Fln.*—*Felden, 21. xi. 96.
L. lutosa, *Stnh.*—*Felden, 23. iii. 97.
L. limosa, *Fln.*—*Felden, 1. iii. 97.
L. geniculata, *Mcq.*—*Felden, 21. xi. 96.
L. pumilio, *Mg.*—*Felden, 20. xi. 96.
L. sylvatica, *Mg.*—*Felden, 18. xi. 96.
L. curtiventris, *Stnh.*—*Felden, 27. ii. 96.
L. ochripes, *Mg.*—*Felden, 17. ii. 97.
L. scutellaris, *Hal.*—*Felden, 24. ii. 96.
L. erratica, *Hal.*—*Felden, 18. ii. 97.
L. clunipes, *Mg.*—*Felden, 7. iv. 97.
L. heteroneura, *Hal.*—*Felden, 27. ii. 96.
L. ? rufilabris, *Stnh.*—*Felden, 16. ii. 97.
L. crassimana, *Hal.*—*Felden, 21. xi. 96.
L. quisquilia, *Hal.*—*Felden, 21. xi. 96.
L. sp. near quisquilia, *Hal.* (inhabits fungus).—*Felden, 21. xi. 96.
L. fungicola, *Hal.*—*Felden, 5. xii. 96.
L. vitripennis, *Ztt.*—*Felden, 21. xi. 96.
L. spinipennis, *Hal.*—*Felden, 30. xi. 96.
L. sp. near minutissima, *Ztt.*—*Felden, 26. ii. 97.

L. melania, *Hal.*—*Felden, 10. iii. 97.
L. litoralis, *Stnh.*—*Felden, 13. iv. 97.
L. leucoptera, *Hal.*—*Felden, 27. iii. 97.
L. aterrima (? Borborus aterrimus, *Hal.*).—*Felden, 8. iv. 97.

Many of the species of Borboridæ in the unincorporated collection have been examined and named by Mr. J. C. Collin, and in some cases his determination as given above differs from Mr. Piffard's. There are also some unnamed specimens from Felden.

PHORIDÆ.

Conicera atra, *Mg.*—*Tring, *A.P.*, 3. v. 97; *Felden, 15. v. 97.
Phora urbana, *Mg.*—*Felden, 23. iii. 97.
P. opaca, *Mg.*—*Felden, 10. iv. 97.
P. abdominalis, *Fln.*—Felden, 10. x. 97.
P. ? incrassata, *Mg.*—*Felden, 1. ix. 99.
P. rufipes, *Mg.*—*Felden, 19. i. 97.
P. ? heraclea.—*Felden, 16. ii. 97.
P. ? nigricornis, *Egg.*—*Felden, 20. iv. 97.
Many unnamed specimens from Felden.

HIPPOBOSCIDÆ.

Ornithomyia avicularia, *L.*—St. Albans (from sparrow), vi. 04; (from owl), x. 04.
Stenopteryx hirundinis, *L.*—St. Albans (from swift), vi. 04; Hemel Hempstead (from sand-martin), *Bullen*, vii. 99.

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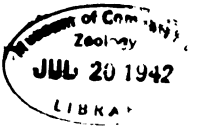
C.



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